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September 1981

Distribution and Abundance of Marine Birds and Mammals Wintering in the Kodiak Area of Alaska

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September 1981

DISTRIBUTION AND ABUNDANCE OF MARINE BIRDS AND MAMMALS WINTERING IN THE KODIAK AREA OF ALASKA

by

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SUMMARY

Forty-four species of seabirds were observed during the winter of 1979-1980 in the Kodiak Archipelago. Data were also obtained for 6 species of puddle ducks, 5 species of shorebirds, 3 species of raptors, and 10 species of marine mammals.

The species composition of seabirds in the area shifted considerably between summer and winter. Density indices derived for bays in November and February of about 84 and 144 birds per square kilometer (B/km^2) respectively, were well above the 50-60 B/km^2 obtained by the same methods, but over a more limited area, during the summer of 1977. The numerical dominance of Tufted Puffins and Black-legged Kittiwakes in summer shifted to numerical dominance of Common Murres, Scoters, and Oldsquaws in winter. Seabirds over the continental shelf, on the other hand, showed a decrease in abundance with the overall density index dropping from 63 B/km^2 in June 1977 to 23 B/km^2 in February 1980. Density indices for shelfbreak and oceanic habitats showed a small increase from about 4 B/km^2 in June 1977 to 7-8 B/km^2 in February 1980. Species composition over deep waters also changed. Sooty and Short-tailed Shearwaters departed for their breeding areas in the southern hemisphere, and murres increased in numbers over the continental shelf. November was a transition period; small numbers of breeding visitors such as kittiwakes were still present and many winter visitors such as eiders had not yet arrived.

Prime habitats for seabirds wintering in the Kodiak area include ice-free estuaries and lagoons for puddle ducks; marine waters less than 25 m deep with rock or boulder substrates for seaducks; and waters near the 100 m isobath in mid-bay areas for murres. The largest concentration of seabirds, both in November and February, was at the Whale Pass-Afognak Strait area near Whale Island. Other areas of special importance were estuarine and lagoon areas at Alitak and Uyak Bays for puddle ducks; Sitkalidak Strait and Uyak Bay for alcids; the Geese-Aiaktalik Islands Channel, Akhiok Reef in Alitak Bay, nearshore waters in Chiniak Bay, and the continental shelf around the Trinity Islands for sea ducks; and Ugak Strait and mid-Sitkalidak Strait for seabirds in general.

PREFACE

The search for oil and gas has accelerated research related to environmental assessment of the outer continental shelf and adjacent marine habitats in Alaska. Information on biological communities in winter are especially lacking in this area. This report describes an investigation of the distribution and abundance of marine birds wintering in the Kodiak Archipelago of Alaska.

All tables and figures have been assembled at the end of the report for ease in referencing. Tables 1-3 document overall survey efforts. Tables 4-7 are from large plane surveys, tables 8-10 are from small plane surveys, and tables 11-17 are from shipboard surveys.

The study was funded by the Bureau of Land Management, Environmental Studies Program, Anchorage, Alaska, and conducted in a cooperative effort by the Biological Services Program, Anchorage, and Kodiak National Wildlife Refuge, Kodiak, Alaska.

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INTRODUCTION

Published accounts of the avifauna of Kodiak Island and its surrounding waters are few and, for the most part, lacking in detail. Gabrielson and Lincoln (1959) summarized all published information up to their publication date, including accounts by Bretherton (1896), Friedmann (1935), Arnold (1948), and Howell (1948). Kessel and Gibson (1978) have summarized records obtained since 1959. Most of the information in these publications is anecdotal and refers to occurrence rather than distribution and abundance per se.

The major body of knowledge of seabirds of the Kodiak Basin has been accumulated by investigators under contract to the Outer Continental Shelf Environmental Assessment Program. For summaries of these investigations see Arneson (1976); Guzman (1976); Lensink and Bartonek (1976a, 1976b, 1976c); Lensink et al. (1976); Wiens (1976); Arneson (1977); Gould (1977); Harrison (1977); Myres and Guzman (1977); Sanger et al. (1977); Wiens (1977); Gould et al. (1978); Hatch et al. (1978); Wiens et al. (1978); and Dick (1979). The only reports which deal significantly with winter distribution and abundance are Arneson (1976) and Dick (1979).

The files of the Kodiak National Wildlife Refuge (KNWR) contain miscellaneous reports of waterfowl surveys from inshore and estuarine areas of the Refuge with the most comprehensive being an aerial survey in March by J. L. Trapp (Aerial Bird Survey of the Coastal Waters of Kodiak Island, Alaska, March 9-14, 1977. Unpublished report, Kodiak National Wildlife Refuge, Kodiak, Alaska) and January-February shipboard surveys by G. Atwell in 1973 (Planning and Accomplishment Narrative, Kodiak National Wildlife Refuge, 1973. Administrative Report, Kodiak, Alaska) and in 1975 (Refuge Narrative Report, Kodiak National Wildlife Refuge: 1 July, 1974 to 30 June, 1975. Administrative Report, Kodiak, Alaska). Since 1973, William Donaldson has coordinated Christmas Bird Counts in Kodiak, and each year a team has covered the Chiniak Bay area by skiff (Donaldson 1974, 1975, 1976, 1977, 1979).

STUDY AREA

Surveys were conducted over inshore, nearshore, and offshore waters of Sitkalidak, Kodiak, and southern Afognak Islands (Figures 1-5). These islands lie within the Coastal and Alaska Stream Domains and are continuously washed by waters from the southwestward flowing Alaska Current System (Favorite et al. 1976). Strong tidal movements into and out of Cook Inlet surge through Shelikof Strait. South of Kodiak Island, the continental shelf consists of a series of shallow banks and deep troughs which produce a varied and complicated oceanic environment. This variety is continued along the coasts which are indented with many deep bays and studded with numerous islets. Features of particular relevance to seabirds wintering in the area are the dominance of rock and gravel substrates underlying shallow, nearshore waters; steep slopes between the shorelines and centers of bays with depths in mid-bay frequently reaching 180 m; and the relatively ice-free conditions of bays, lagoons, and estuaries during the winter.

Marine waters of the Kodiak Archipelago are extremely productive and provide for an extensive fisheries industry including salmon, crab, and shrimp. The operations of canneries and fishing boats play an important role in concentrating marine birds and mammals by providing a locally abundant and rich food source. The areawide abundance of euphausiids and capelin, the principal components in the diets of local seabirds, is of even greater importance. Capelin are currently being considered for commercial exploitation and a serious conflict could arise between economic development in the area and the protection of local marine bird stocks.

The rugged coastline provides important shelter for over 140 seabird rookeries and 350,000 breeding birds (Sowls et al. 1978). The three largest colonies, each containing 30,000-60,000 birds, are located on Boulder Bay on Kodiak Island near the eastern entrance to Sitkalidak Strait, Flat Island on the south side of the Aliulik Peninsula, and the Triplet Islands in western Marmot Bay. Tufted Puffins and Black-legged Kittiwakes make up about 57% and 30% respectively of these breeding seabirds. Marine mammals are also abundant throughout the area. Sea Otters are currently repopulating Kodiak Island from Afognak and the Barren Islands. Sea Lions and Harbor Seals have major haul out areas on Kodiak and major rookeries on nearby islands. The continental shelf off southern Kodiak lies within the major migration routes of Fur Seals and Gray Whales.

WEATHER PATTERNS

One of the major gaps in biological data for the Gulf of Alaska is knowledge of winter populations and distributions, the principal reason for this being the frequent occurrence of storm conditions. Weather patterns had a twofold effect on our survey results. First, weather affected the timing, duration, and location of surveys. Our 15 m research vessel, the URSA MAJOR, was not capable of manuevering in high seas and was thus restricted to protected bays for most of the winter.

Even within the bay systems of Kodiak there were periods when the ship had to remain at anchor in well sheltered areas. Thus, our November surveys continued into December, and we were able to complete only a few transects in the open waters of Marmot and outer Chiniak Bays.

Aerial surveys were particularly hard to schedule because, in addition to storms, periods of overcast and low ceilings prevented surveys from being conducted or completed. Secondly, seabirds are quick to respond to changing weather and oceanographic conditions such as are associated with the passage of storm fronts, but the level or type of response varies with each species. The effect of weather conditions on the distribution and abundance of seabirds in the Kodiak area is largely speculative at the present time. Our surveys were not designed to answer this question and our data allow little in the way of concrete conclusions.

Marine weather patterns for winter in the Kodiak Archipelago generally involve high winds from the northwest with mean speeds of 16.9, 19.1, 15.5, and 16.6 knots in November, December, January, and February respectively (Brower et al. 1977). Precipitation is generally around 12.7 cm per month and occurs on a monthly average of about 20-26% of reporting days. Monthly mean air temperatures range between 1.8-4.2° C and monthly mean sea surface temperatures range between 3.0-7.5° C (Brower et al. 1977). Storms are frequent in the area. The winter of 1979-1980 in Kodiak was moderate, being neither more nor less severe than average. Salient climatological events during our surveys included the following.

November

The season's first snowfall occurred this month. A storm on 27 November brought 90 knot winds to parts of Kodiak and the URSA MAJOR rode out the storm in Shearwater Bay. For most of the month storms with high winds and seas prevented the URSA MAJOR from venturing far outside the protection of bays. Surface water temperatures obtained from bucket samples during transects ranged from 3.9-8.1° C. Estuarine waters of Izhut Bay were frozen, especially Saposa Bay which was covered by about 8 cm of ice.

December

Persistent strong winds occurred in the early part of this month. Average air temperatures and total precipitation were below normal. Karluk Lake froze over on 31 December, the last of the interior refuge lakes to become icebound.

January

Air temperatures were below normal for the first 2 weeks. This cool period was followed by very warm weather and rain for about 10 days and then a return to average conditions.

February

Air temperatures and precipitation were above average. Storms and rough seas prevented us from conducting transects very far out over the continental shelf around Kodiak Island. Periods of clear, cold weather created a thin layer of ice in several back bays and prevented data collection in Shearwater Bay and Port Hobron. Surface water temperatures obtained from bucket samples during transects ranged from 1.0-4.4°C.

METHODS

Our methods were designed to accumulate the maximum amount of information, on the distribution and abundance of marine birds, that is possible within realistic time, money, logistics, and environmental constraints. The basis of our surveys is a short strip census (Kendeigh 1944) with a width of 300 m from ships and 50 m from aircraft. In particular, our efforts have been directed towards deriving indices of density from short, simple, and easily reproduced transects. These indices, although not "beak counts", are consistent within the data base and provide accurate baseline data needed to define and interpret fluctuations in the size and distribution of populations within and between areas and time periods. They also allow, as reasonably as any other method, a prediction of population size which, depending on sample size, is adequate for most environmental assessment needs.

Several special procedures have been incorporated into our census techniques to provide flexibility in data analysis and to improve the accuracy of density estimates. These procedures include the following:

- the use of both ship and aircraft as platforms;
- the use of standardized and coded, experimental designs;
- the incorporation of all significant observations of birds outside the census area into the data base;
- instantaneous counts of flying birds; and
- a forward scan to the projected end of the transect.

Aerial surveys are most cost-effective in covering large geographical areas in a short period of time, and we restricted their use to this purpose. The rapidity with which specific areas are covered, however, seriously reduces the observer's time to detect individual birds. This is one reason why widths of aerial transects were restricted to 50 m. The speed of passage and reduced observation zone also decrease the chances of detecting uncommon species and reduce the observer's ability to identify individual birds. Shipboard surveys, in contrast, were effective in assessing short-term and local fluctuations in populations and resulted in more observations of uncommon species with a higher proportion of individuals identified to species. Four very different platforms were used in our surveys, their use depending on the habitats to be covered. These platforms included a large twin-engine plane, a small single-engine plane, a 15 m ship, and a small skiff.

LARGE PLANE SURVEYS

Surveys of continental shelf, shelfbreak, and oceanic habitats surrounding Kodiak Island were conducted on 16-17 February 1980 from a Grumman Turbogoose. A total of 151 transects covering an area of 207.58 km^2 were completed (Table 1) over the same flight path flown in other seasons (Figure 6). Transects were conducted only when experienced observers determined that weather and observation conditions were good enough to allow enumeration of all birds within the counting zone. The aircraft was equipped with a Global Navigation System (GNS-500) which provided a continuous readout of latitude and longitude. Surveys were flown at 220-225 km/hr and an altitude of 30-50 m. Birds were counted in 50 m wide strips on each side of the plane and the data combined to produce one 100 m transect. Two biologists with previous aerial experience conducted observations while a third recorded locations. Assignments were rotated regularly to ease eyestrain. Surveys followed lines of latitude and longitude whenever possible and were selected to maximize the ratio of hours of actual survey time to the total hours of flying time. All observations were recorded and analyzed by transect segments encompassing 10 minutes of latitude for north-south censuses or 5 minutes of longitude for east-west censuses.

SMALL PLANE SURVEYS

Coastline surveys were conducted from a Cessna 185 during 6 days between 7 February and 1 March 1980. Kodiak Island and adjacent isles were surveyed except for Northern Afognak Island, the Trinity Islands, and the outer coast of Kodiak Island between Uyak and Uganik Bays. A total of 2,934 km of coast was covered in a little over 25 hours of flight time. The plane stayed 150-200 m from the shoreline and all birds observed between the plane and the shore were counted. This method differed from the surveys completed by Trapp (1977), who flew 460 m from shore and only counted birds within the first 200 m of the plane. Also, Trapp only surveyed selected portions of the Kodiak coastline and none of the outlying islets. Our surveys were flown at an altitude of 30-50 m and observations were made by both the biologist and the pilot. Species identification and enumeration were greatly improved by two observers working the same transect area in unison.

SHIP SURVEYS

In theory, we would like to get an instantaneous count of birds within the transect zone. Actually, our strip censuses are based on a 10 minute (temporal) cruising time with the ship moving along a straight path at a constant speed (usually 7-9 knots). The observer counted all birds observed forward of midship, and laterally on one side, to 300 m. The forward scan was extended to the projected end of the transect (maximum of 3,000 m at 10 knots). The extended forward scan increased the detection of birds which may have left the area or dived before the ship reached them. This extended scan is important for ship-avoiding species. Birds observed beyond the transect boundary and those following the ship were recorded separately and not included in our estimates of density.

Flying birds present a special problem. Estimates of densities would be greatly exaggerated if the observer counted all the individuals flying through the transect zone. In order to reduce this bias, we conducted periodic "instantaneous" counts of flying birds within a discrete portion of the transect area. The number of such counts depended on the length of transects and the distance birds could be seen and identified. For example, on a 10 minute transect at a speed of 10 knots the ship would cover 3,087 m. We would make three instantaneous counts, one each at 3 minute intervals beginning at the start of the transect, using a 1,000 by 300 m area. These three counts were then added together to produce the number of flying birds in the census area. We would use 2 counts at 7 knots; 4 counts at 13 knots, and 5 counts at 16 knots. Care was taken to avoid counting the same birds twice.

The timing and number of transects on each day of a cruise depended on weather and daylight. All data were collected by use of continuous transects. Transect widths were estimated by experienced observers, and occasionally a float was towed behind the ship to verify the 300 m distance.

Shipboard surveys were conducted from the Research Vessel URSA MAJOR during good weather conditions on 20 days between 8 November and 5 December, and 19 days between 16 February and 8 March. Three-hundred sixty-eight transects were completed in November covering an area of 302.1 km^2 (Table 2). Four hundred and ninety nine transects were completed in February covering 408.2 km^2 (Table 3). These surveys were primarily limited to bay systems although a few trips were made over the nearby continental shelf (Figures 7-9). Transects were not randomly located; transect paths were deliberately selected to sample all areas of the bay by zigzagging from shore to shore, each transect crossing the bay. The length and direction of each transect were determined by the ship's speed, the 10-minute transit time, and obstacles in the water. We believe the shore to shore transect is the best method for sampling a bay because both nearshore and deeper water habitats are included.

SKIFF SURVEYS

Skiffs were used to qualitatively evaluate some habitats and to ground-truth counts within some of the more important estuaries and lagoons covered by small plane surveys. Twenty surveys were completed in November (Table 2) and 25 were completed in February (Table 3). The ground truth surveys indicated that small plane transects underestimated populations by 15-25%, especially when large numbers of ducks were present.

DISCUSSION

Each survey technique has its own strength or weakness, and the relative value of each has been discussed by many previous investigators (e.g., Briggs et al. 1978, Gould et al. 1978, Wiens et al. 1978). Basically, we used a large plane to census continental shelf, shelf-break, and oceanic habitats; a small ship to survey bay and nearshore areas; and a small plane to survey shorelines, backbays, estuaries, and lagoons.

Estimates of populations over the continental shelf are derived only for seabirds which are widely distributed. Loons, grebes, cormorants, ducks, and geese are too local or spotty in their distributions to make such estimates meaningful on the basis of our restricted flight path. Estimates for the remaining species are based on an area extending north to 59° N, east to 150° W, west to 156° W, and south to the 2,000 m isobath, but exclude offshore waters of the Alaska Peninsula. The Kodiak Shelf has a total water surface of about 74,635 km^2 (Table 1). Estimates of bay and nearshore populations are based on areas covered by ship and small plane surveys and include all of Kodiak and Sitkalidak Islands as well as the southeastern portion of Afognak Island. This region of bays and fjords contains about 3,545 km^2 of surface waters (Tables 1-3).

SPECIES ACCOUNTS

Forty-four species of seabirds were found in our surveys of the Kodiak Archipelago from November 1979 through March 1980. Six species of puddle ducks, 5 species of shorebirds, 3 species of raptors, and 10 species of marine mammals also were identified. The following section is an annotated account of each of the species observed during our studies.

LOONS

Small numbers of loons occur in the Kodiak Archipelago throughout the year. In winter, we found them only in bays, and largest numbers occurred in Uganik Bay (Tables 9, 15-16). On the basis of small ship surveys (Table 17), we estimate a population of over 1,100 loons wintering in Kodiak.

COMMON LOONS *(Gavia immer)*accounted for 70% of those loons identified to species in our surveys. One flock of 56 birds was observed nearshore in Uganik Passage in February.

YELLOW-BILLED LOONS (*Gavia adamsii)* were sighted three times in November and four times in February. These sightings were scattered around Kodiak Island.

ARCTIC LOONS *(Gavia arctica)* were found twice on the November cruise. These were probably late migrants because we did not find this species in the February surveys.

RED-THROATED LOONS (*Gavia stellata)* were found only on the November cruise. The six individuals observed were probably late migrants.

GREBES

Grebes are resident in small numbers throughout nearshore areas in the Kodiak Archipelago. We found them in winter only in bays; the largest numbers occurred in Uyak Bay and Sitkalidak Strait (Tables 9, 15-16). Density indices from shipboard transects (Table 17) indicate a population of about 2,250 grebes in Kodiak bays in winter.

RED-NECKED GREBES *(Podiceps grisegena)* accounted for 82% of the 224 grebes identified to species in our surveys. Generally a nearshore inhabitant, they were observed up to 1 mile from shore in flocks of up to 14 birds.

HORNED GREBES *(Podiceps auritus)* were probably underestimated by us and many of the unidentified grebes were probably this species. Most of the birds identified as belonging to this species were observed in Uganik Bay and Sitkalidak Strait during the February survey.

FULMARS-SHEARWATERS-PETRELS

Four species of the order Procellariiformes were found on our surveys. All were restricted to deep offshore habitats, in particular shelfbreak waters between the 200 m and 2,000 m isobaths (Table 5).

NORTHERN FULMARS *(Fulmarus glacialis)* occurred on 58% of the aerial transects conducted over shelfbreak and oceanic waters in February. Only one bird was sighted on the continental shelf and density indices were higher for shelfbreak habitat than for oceanic habitat (Table 5). The frequency and abundance indices obtained for fulmars over shelfbreak and oceanic habitats in February (Tables 5-7) were higher than those obtained in other seasons (Gould et al. 1978) suggesting fulmars are most abundant in Kodiak waters during the winter. Only 56 birds were seen in Shelikof Strait, all on a single transect; aggregations elsewhere were much smaller, usually consisting of five or fewer birds. Eighty eight percent of all fulmars seen were dark-phase. Hatch (1979) found that about 86% of the fulmars associated with the Semidi Islands colonies were dark phase. It thus appears that there is no major influx of light-phase breeders from the Bering Sea to Kodiak waters in winter. We estimate a wintering population of about 77,000 Northern Fulmars over the Kodiak Shelf.

SOOTY and SHORT-TAILED SHEARWATERS *(Puffinus griseus and P. tennuirostris)* were encountered in small numbers over waters deeper than 2,000 m. They occurred usually as singles or in groups of two or three. Several were sighted over the shelfbreak, but only one was found over the continental shelf. One Short-tailed Shearwater was found in Sitkalidak Strait and one unidentified shearwater was observed in Shelikof Strait in November. We estimate that about 2,700 shearwaters may remain over shelf and shelfbreak habitats through the winter.

FORK-TAILED STORM PETRELS *(Oceanodroma furcata)* were mostly found far offshore, with 87% occurring beyond the 2,000 m isobath in the February survey. Beyond this isobath, Fork-tails were common, occurring on 58% of the transects and averaging 1.8 B/km^2 (Table 5). This density index is below that found in the same area in March 1977 but higher than those recorded in other months (Gould et al. 1978). Generally they were observed in loose flocks of less than 10 birds. Only two were sighted on the shelfbreak, and a single group of five was observed on the continental shelf near the large rookeries in the Barren Islands. Somewhat over 3,200 Fork-tailed Storm-petrels may winter around the Kodiak Archipelago.

LEACH'S STORM-PETRELS *(Oceanodroma leucorhoa)* were sighted only twice. These sightings were in February, one bird over oceanic waters and one bird over the shelfbreak. Both birds were south of 56°N suggesting that Leach's Storm-petrel may be restricted to warmer waters than its congener. Storm-petrels were not observed in Shelikof Strait.

CORMORANTS

Three species of cormorants are resident in Kodiak waters but we made no attempt to distinguish between the two most common species: Red-faced and Pelagic Cormorants. Most Double-crested Cormorants, in contrast, were easily recognized. Cormorants generally were rather uniformily distributed throughout bays and along rocky coastlines of the Kodiak Archipelago (Tables 9, 15-16). Density indices of 5.2 B/km^2 for November and February (Table 17) indicate a stable winter population and are far above mean indices for May-November 1977 of 0.01-1.50 B/km^2 obtained by the same methods but in far less critical habitats (Gould et al. 1978). We estimate that 40,000 cormorants winter in bay and inner continental shelf areas of Kodiak.

DOUBLE-CRESTED CORMORANTS *(Phalacrocorax auritus)* were uncommon, only six having been found in November and three in February. All were from bays on the eastern side of Kodiak. Dick (1977) estimated 200-300 wintered in Chiniak Bay.

PELAGIC and RED-FACED CORMORANTS *(Phalacrocorax pelagicus and P. urile)* were common throughout the area with flocks as large as 105 and 125 birds observed in Kiliuda Bay and Western Sitkalidak Strait. We flushed two cormorants from the water while crossing a bay near midnight. These birds normally roost on land and their feathers are not as waterproof as other seabirds, consequently the latter observation could indicate nocturnal feeding. Dick (1977) estimated a Pelagic and Red-faced Cormorant ratio of 10:1 in Chiniak Bay in the winter of 1976-77.

GEESE

Winter populations of geese are low and mostly limited to Emperor Geese.

CANADA GEESE *(Branta canadensis)* were found only once. Seven large, dark-bellied Canada Geese were observed on the mudflats area of Zachar Bay on 27 February. These could have been early spring migrants or possibly remnants of a private Canada Goose introduction attempted in the mid-1970's.

EMPEROR GEESE *(Philacte canagica)* were principally birds of rocky intertidal areas. Two birds were seen flying into Uyak Bay on 12 November. February coastline surveys located them in four areas: 195 birds on Middle Bay; 46 birds near Black Point; 162 birds on the Geese Islands; and a concentration of 630 on-transect and 591 off-transect north of Cape Alitak. Some of the geese off the coast north of Alitak were sitting on the water and others were flying towards the Trinity Islands. We suspect that they had previously been chased out of a nearby lagoon or from islands near Akhiok because the area where they were found is not typical habitat. The Trinity Islands may provide a refuge for these birds at night. We believe that most of the Emperor Geese in the area were seen and we estimate approximately 1,650 birds on

Kodiak Island. The Trinity Islands were not included in our census and significant numbers of Emperor Geese may occur there.

PUDDLE DUCKS *(Anas* spp.)

We found six species of puddle ducks wintering in lagoons, estuaries, and backbays of the Kodiak Archipelago and three additional species *(Anas discors, A. poecilorhyncha,* and *A. penelope)* have been recorded as rare visitors by other investigators (Kessel and Gibson 1978). This group of species was censused by skiff in some bays and by small plane in all backbays and coastal lagoons. In areas which were surveyed by both types of platform, we found the aerial counts to be 15-25% below that of the small boat counts. Puddle ducks seem to be flushed by small boats long before a plane will cause them to fly. In several areas the plane did not flush the ducks, consequently many were undoubtedly missed. During skiff surveys, a gun was fired to scare ducks into the air. This greatly improved the accuracy of our counts. If a 15% correction factor is applied to data from aerial surveys, a conservative estimate of 11,500 puddle ducks winter in the study area.

MALLARDS *(Anas platyrhynchos)* were the most abundant member of this group and were found in every backbay and lagoon surveyed. The largest number was located in Uyak Bay where over 2,000 were counted on each of two skiff surveys. A small plane survey of this area, however, revealed only 1,570 birds. Previous surveys by staff of the KNWR and Alaska Department of Fish and Game (Table 8) have found as many as 2,400 mallards in Uyak Bay. Other locations harboring large numbers of Mallards include Zachar Bay, Spiridon Bay, Portage-Sula Bays, and McDonald Lagoon. We counted a total of 8,176 Mallards on the aerial coastline survey (Table 9) but estimate the estuarine and lagoon population is nearly 10,100 if 92% of the unidentified puddle ducks is added and a 15% correction factor is applied.

PINTAILS *(Anas acuta)* were the second most abundant puddle duck, but were observed in only 7 areas and on only 14% of the 51 coastline surveys; a total of 558 birds were counted (Table 9). Lazy Bay and Alitak Lagoon contained 344 birds or 61% of the total. We estimate that at least 650 Pintails winter in Kodiak.

AMERICAN WIGEON *(Anas americana)* were uncommon in the area. Only 12 were found on coastline surveys (Table 9) but 207 were counted in skiff surveys. We are unable to explain the difference because widgeon should be quite conspicuous from the air. There are probably more than 250 American Widgeon on Kodiak.

GADWALL *(Anas strepera)* are uncommon in the Kodiak area. We found a total of 33 birds on three coastal surveys (Table 9) and 9 birds on three shipboard transects (Table 16). We estimate that over 50 Gadwall winter in Kodiak.

GREEN-WINGED TEAL *(Anas crecca)* were the third most abundant puddle duck in the area. They are small, inconspicuous, and hard to flush. Thus they may be overlooked, especially when mixed in with large numbers of other ducks. The largest flock encountered was in Uyak Bay where 80 were observed from a skiff but none were found from a small plane in the same area. This discrepancy leads us to believe that there are more of these teal in the area than are usually found and we estimate between 400 and 500 may winter in Kodiak.

SHOVELERS *(Anas clypeata)* were recorded only once. Four birds were found on a small boat survey of Kiliuda Bay on 18 February. This is apparently the first midwinter record for this species in the Kodiak area.

SEA DUCKS

Fourteen species of sea ducks were found in our surveys and another eight species *(Aythya valisineria, A. americana, A. collaris, A. affinis, A. fuligula, Somateria fischeri, Mergus albellus*, and *Lophodytes cucullatus)* have been recorded by other investigators (Donaldson 1974-1977, 1979; Kessel and Gibson 1978). In winter, this group of birds makes up 30-35% of the avifauna in bay systems of the Kodiak Archipelago (Table 17), with the percentage in local areas ranging from 10-70%. Chiniak Bay, Whale Passage, and Alitak Bay generally had the highest percentages and densities of sea ducks.

GREATER SCAUP *(Aythya marila)* were the only scaup identified in our surveys. A total of 3,383 was counted on the coastal surveys (Table 9). Flocks of 250 or more birds were found in Barling Bay, Kaiugnak Bay, Alitak Lagoon, and Womans Bay. Lower densities in November than in February indicated that migration was still in progress in November (Table 17). A conservative estimate would be that 3,500-4,000 Greater Scaup winter in Kodiak.

COMMON and BARROW'S GOLDENEYES *(Bucephala clangula and B. islandica)* were common in nearshore waters of the Kodiak Archipelago during both November and February and there was little difference in density between the two months (Table 17). Barrow's Goldeneye was the most abundant goldeneye in marine waters and accounted for 97% and 84% of the goldeneyes identified to species in November and February respectively. Goldeneyes are one of the species most easily counted in small plane surveys of the shoreline. We believe that almost 100% of the birds were accounted for because they usually flew at the approach of the plane, and most were within 50 m of shore. A total of 7,036 were counted along the entire shoreline surveyed (Table 9) but this number is increased to 8,700 if appropriate percentages of unidentified sea ducks and *Bucephala* sp. are added. Two of the highest density areas for Goldeneyes were Alitak and Olga Bays. Common Goldeneyes were probably most common in freshwater areas which we did not survey. Common Goldeneyes far outnumbered Barrow's Goldeneyes on Christmas counts which included both freshwater and marine habitats (Donaldson 1974-1977, 1979).

BUFFLEHEADS *(Bucephala albeola)* were common in backbays throughout the Archipelago. We found them most abundant in Sitkalidak Strait (Tables 9, 15-16). A change in density was not detected between November and February (Table 17), thereby indicating that the wintering population had arrived by the time of our first survey. A total of 3,151 was counted on our coastal surveys, and another 265 unidentified *Bucephala* made 3,416 birds recorded on the survey. We believe that 4,500-5,000 Bufflehead winter in Kodiak.

OLDSQUAWS *(Clangula hyemalis)* were encountered throughout bay and nearshore habitat (Figures 10-16). Flocks of 200-1,600 were found off rocky headlands, the largest flocks being in outer Natalia Bay, Whale Pass, and the northeast arm of Uganik Bay. Density and frequency indices for this species increased from November to February (Table 17), thereby indicating that birds are still moving into the area in November. Oldsquaws are difficult to census because of their clumped distribution and their tendency to dive for prolonged periods at the approach of an airplane or ship. Coastal surveys miss all of the birds in the middle of bays and our shipboard surveys probably overestimated their numbers by moving through the middle of the largest flocks. We agree with Dick (1977) that this species is the most abundant waterfowl in bays of Kodiak Island. Our best estimate is that about 65,000 Oldsquaws winter in Kodiak bay and nearshore areas, and that many additional birds occur over the nearby continental shelf.

HARLEQUIN DUCKS *(Histrionicus histrionicus)* were inconspicuous inhabitants of rocky coastal habitats. Many are permanent residents. They nest in freshwater habitats and move into the bays in late summer. From shipboard data (Table 17) we calculate a Kodiak population of about 9,600 birds. Coastal surveys accounted for only 4,931 Harlequins. Although most of the population should have been within the 200 m counting zone, we assume many were missed because they are dark, appear in small groups, and often dive rather than fly at the approach of the plane. The largest concentrations of this species were found in the Sitkalidak Narrows-Midway Bay area and between Ugak Island and Narrow Cape.

STELLER'S EIDERS *(Polysticta stelleri)* were the most widely distributed of all eiders and were found in small numbers in most bays (Table 9). This was the only species of eider identified in our November survey and their abundance increased between then and February (Table 17). The occurrence of Steller's Eiders in both coastal and mid-bay areas makes it difficult to estimate the size of their overall population. Three hundred and twenty were counted on coastal surveys and the shipboard density index for February equates to about 1,000 birds. Our best guess is that 1,000-1,200 wintered in Kodiak in 1980 with perhaps the greatest numbers in Chiniak Bay. Dick (1977) believed that this was the second most abundant waterfowl in Chiniak Bay and estimated a population of 1,500-2,000 in the winter of 1976-77. Populations probably vary between years and may be dependent on weather patterns in other wintering areas.

COMMON EIDERS *(Somateria mollissima)* were found in small numbers in eastern Sitkalidak Strait and Chiniak Bay in February (Tables 9, 16). None were identified in November (Table 15). Christmas bird counts in Chiniak Bay have found a high of 375 (Donaldson 1975). A winter population of 400-500 is our best guess for Kodiak bays but more extensive surveys of the inner continental shelf will be needed before a really accurate estimate can be made.

KING EIDERS *(Somateria spectabilis)* were by far the most abundant eider in the Kodiak area. They were identified in 5 of 13 bays on coastal surveys, and 8 of 12 bays in February shipboard surveys (Tables 9, 16). However, King Eiders were generally nearly absent from northwest Kodiak and uncommon in southeast Kodiak. None were identified in November (Table 15). Largest numbers occurred in western Chiniak Bay, Whale Pass, Ouzinkie Narrows, Akhiok Reef, Geese Channel, and between Narrow Cape and Ugak Island (Tables 9, 16, Figures 10-16). Many of the eider flocks found near Tugidak Island and in Katmai Bay (Figure 17) were probably this species. King Eider numbers appear to fluctuate widely from year to year as exemplified by the 4,500 found in Whale Pass in 1975 (Atwell 1975) compared to only 500 found there in our February survey. Kodiak represents the eastern boundary of this species' winter range and environmental variations between years, especially in the Bering Sea, are probably responsible for these population fluctuations. Twenty-six percent of the 351 King Eiders recognizable to sex were males over 1.5 years of age. Estimates of population size derived from shipboard surveys (Table 17), and adjusted for unidentified eiders, indicate a maximum of about 13,000 birds in Kodiak bays during the 1979-80 winter season. Many thousands also may occur over the shallow continental shelf around the Trinity Islands and northern Afognak Island.

WHITE-WINGED SCOTERS *(Melanitta deglandi)* were found in shallow nearshore waters, but appeared to prefer habitats somewhat farther offshore than Black Scoters. The White-winged Scoter was the most abundant scoter found in shipboard surveys, but Black Scoters were the most abundant scoter found in nearshore aerial surveys. Large numbers of White-winged Scoters were located in Ugak Strait, Afognak Strait, Katmai Bay, and shallow coastal waters between Uyak and Uganik Bays. Density indices from the February cruise (Table 17) indicate that 29,000 winter in Kodiak bays and we believe that a total of 35,000 would be conservative for Kodiak if the birds along the outer coasts were enumerated. We also suspect that there are many thousands over the shallow shelf surrounding Northern Afognak and the Trinity Islands.

SURF SCOTERS *(Melanitta perspicillata)* accounted for only 6-8% of the scoters identified to species on our surveys. They were regularly observed in nearshore waters but seldom in flocks larger than 10 birds. Coastal surveys found 1,843 birds, a total which increases to almost 2,600 if appropriate percentages of unidentified scoters and sea ducks are added (Table 9). Ship surveys indicated a doubling of birds between November and February and density indices from the latter month convert to an estimated 4,300 Surf Scoters wintering in Kodiak bays. If one adds to this figure birds from the outer coasts, then the total population of Kodiak probably exceeds 5,000.

BLACK SCOTERS *(Melanitta nigra)* were found throughout most of the nearshore fringe of Kodiak Island out to a depth of about 28 m. Densities were highest in northern bays especially near Whale Pass. The Black Scoter population, as determined from shipboard surveys, doubled from November to February (Table 17). This scoter was the most abundant species found on coastal aerial surveys in which 19,153 were identified (Table 9). They made up 80% of the scoters identified to species in that survey so that if we apply appropriate percentages of unidentified birds from coastal surveys we come up with a population of about 26,000 birds.

Similar estimates were derived from shipboard surveys (Table 17) in which highest densities were found in the Whale Pass area. We estimate that at least 30,000 Black Scoters winter in bay and nearshore habitats of Kodiak Island. Prime scoter habitat over the shelf was not properly sampled because surveys were designed for more pelagic species. Black Scoters are the third most abundant species of waterfowl in bay systems of Kodiak Island and may be the most abundant waterfowl over the Kodiak Shelf.

COMMON MERGANSERS *(Mergus merganser)* constituted 37% of the 253 mergansers identified to species on coastal surveys (Table 9) but only 25% of the 143 identified on the February shipboard cruise (Table 16). This difference in percentages may indicate a greater preference than Red-breasted Mergansers have for nearshore habitats. Mergansers are difficult to separate from goldeneyes and we have probably underestimated their numbers. They were fairly well distributed around Kodiak Island with largest numbers found in nearshore areas of Chiniak Bay. We estimate that a total of about 500 Common Mergansers winter in Kodiak.

RED-BREASTED MERGANSERS *(Mergus serrator)* were common in most of Kodiak Islands coastal waters. Largest numbers were found in Uyak and Uganik Bays, Ugak Strait, and the western Sitkalidak area. We estimate about 1,000 winter around Kodiak Island.

RAPTORS

Raptors were uncommon in our surveys. Of the three species observed, the Bald Eagle was the most abundant species, and Marsh Hawks and Pergrine Falcons were rare.

BALD EAGLES *(Haliaeetus leucocephalus)* were conspicuous inhabitants of the coastal bluffs and trees. An attempt was made to count all eagles encountered on the coastal surveys but by no means were all eagles found. Immature birds are especially hard to identify in areas with heavy evergreen forests. Most eagles were in pairs, usually on offshore stacks or bluffs along the coast. A total of 476 birds were sighted (Table 9) of which 75% were adults. Especially high numbers were 54 in Uyak Bay, 100 on Sitkalidak Island, 34 on islands near the town of Kodiak, and 70 along the Alitak Peninsula and nearby islets. The island contained 0.5 Bald Eagles per km of coastline. Dick (1977) estimated 100-200 wintered in Chiniak Bay in 1976-77. We estimate 500-700 winter along the coastal fringe of Kodiak Island and associated islets.

MARSH HAWKS *(Circus cyaneus)* are uncommon visitors to Kodiak. One female was observed at Cape Chiniak on 26 November.

PEREGRINE FALCONS *(Falco peregrinus)* are fairly common residents on Kodiak Island. We found one immature bird in each of the two shipboard surveys. Both birds were very dark; one was beginning to show slight facial markings. On 17 November one falcon made numerous stoops on Crested Auklets flushed by the ship in Whale Pass and Afognak Strait. On 18 February another falcon was observed in Pivot Point Lagoon, Kiliuda Bay. This bird dove at a Bufflehead and a Green-winged Teal flushed by the skiff.

SHOREBIRDS

Shorebirds were enumerated on the coastal surveys, but many remained unidentified and we assume many were missed. Kodiak is not a major wintering grounds for these birds.

BLACK OYSTERCATCHERS *(Haematopus bachmani)* were mostly concentrated in three flocks of about 100 birds each; one flock in western Sitkalidak Strait and two in Chiniak Bay. Small numbers were found in Uyak Bay and along the outer coasts.

BLACK TURNSTONES *(Arenaria melanocephala)* were found in Sitkalidak Strait and along the southern coast of Kodiak Island (Table 9). Only 110 were counted on coastal surveys and the population is probably much higher.

ROCK SANDPIPERS *(Calidris ptilocnemis)* were probably the most abundant shorebird wintering on Kodiak Island. Only 350 were identified but we believe the majority of the 1,089 unidentified sandpipers were this species (Table 9). Fifteen hundred birds would be a conservative estimate for the study area.

PECTORAL and SHARP-TAILED SANDPIPERS *(Calidris melanotos and C. acuminata)* were observed in McDonald's Lagoon on 29 November. Rain prevented positive identification. Both species are fairly common migrants in the area.

SANDERLINGS *(Calidris alba)* are rare visitors to Kodiak. One bird was oberved on Narrow Cape beach on 6 March, an exceptionally early migration date.

PHALAROPES

NORTHERN PHALAROPES *(Lobipes lobatus)* were the only species of phalarope identified in our surveys. Two single birds were seen, one in Uyak Bay on 11 November and one in Izhut Bay on 20 November. Five phalaropes found in Uyak Bay on 11 November were probably this species. These sightings constitute exceptionally late records for this species because most phalaropes move south through Kodiak waters in September and October.

GULLS

We found six species of gulls on our surveys of the Kodiak Archipelago. Four other species *(Larus schistisagus, L. thayeri, Rissa brevirostris,* and *Xema sabini)* have been recorded as migrants or winter visitors by other investigators (Kessel & Gibson 1978; Donaldson 1974-77 and 1979). We also noted three birds which were Herring x Glaucous-winged hybrids.

GLAUCOUS GULLS *(Larus hyperboreus)* are uncommon visitors to the Kodiak area. We found two birds in western Sitkalidak Strait in November.

GLAUCOUS-WINGED GULLS *(Larus glaucescens)* were common out to the outer continental shelf in all areas visited. Their numbers and frequency of occurrence (Tables 13-14, 17) remained the same between November and February, thereby indicating a rather stable winter population. Our estimate of 5,500-7,000 birds wintering in bays is identical to the number estimated to occur in the same area in the summer (Gould et al. 1978). Populations over the continental shelf, however, seem to be larger in winter. Our best estimate is that about 45,000 Glaucous-winged Gulls occur over the Kodiak Shelf in winter. This is four times the number estimated for the summer of 1977 (Gould et al. 1978).

HERRING GULLS *(Larus argentatus)* are regular, nonbreeding visitors to Kodiak; we found two in November and one in February.

MEW GULLS *(Larus canus)* are nearshore inhabitants and inland breeders in most areas of Kodiak. Summer densities in marine habitats are consequently low, ranging from 0.01 to 0.14 B/km^2 (Gould et al. 1978). November and especially February density indices for bays were much higher, 1.53 - 2.11 B/km^2 (Table 17). Our estimate for wintering birds in bay and nearshore waters of Kodiak is 10,000. This number appears too high for the breeding population and it probably includes birds from areas such as the Alaskan Peninsula and Yukon Flats. Dick (1977) estimated that 1,000 - 2,000 wintered in Chiniak Bay in 1976-77.

BLACK-LEGGED KITTIWAKES *(Rissa tridactyla)* were common in November. Feeding flocks of both adults and immatures were observed in all areas with especially high numbers in western Sitkalidak Strait, Uyak

Bay, Uganik Bay, and Kiliuda Bay (Figures 10, 12, 14). Nearly 700 birds remained near the Boulder Bay colony until at least 2 December. Density indices in November and February (Table 17) were much lower than the 9.6-12.4 B/km^2 found in the summer of 1977 (Gould et al. 1978). Most kittiwakes observed in February, 149 of 248 birds, were associated with the Cape Chiniak colony. By 1 March, 900 birds were found on the Cape Chiniak Colony itself or over nearby waters. This represents an exceptionally early return of birds to a breeding colony in the area. Dick (1977) first saw birds at the Gibson Cove Colony on 1 April.

In February, kittiwakes were most abundant over the shelfbreak. The density index for that area was 2.05 B/km^2 (Table 5), a value higher than similarly obtained indices of 1.2-1.3 B/km^2 for the summer of 1977 (Gould et al. 1978). Flocks over these deeper waters did not usually exceed 10 birds, although a few flocks as large as 60 birds were seen outside of the census zone. We estimate that about 65,000 kittiwakes occur over the Kodiak Shelf in winter, 75% of which are over waters deeper than 200 m.

BONAPARTE'S GULLS *(Larus philadelphia)* are uncommon migrants in the Kodiak area. We found three immature birds in a feeding flock of kittiwakes in inner Uyak Bay on 10 November.

ALCIDS

Eleven species of alcids were observed in our surveys of the Kodiak Archipelago. Common Murres were numerically dominant in all areas with Crested Auklets a poor second in bays. Alcids accounted for 43% and 60% of the birds observed on shipboard surveys in November and February respectively, and for 56% of the birds found on aerial surveys over offshore waters.

COMMON and THICK-BILLED MURRES *(Uria aalge and U. lomvia)* were found in a ratio of about 30:1 in bays. In November, most Common Murres were in winter plumage while the Thick-bills were just beginning postnuptial molt. Many immature murres were observed in November with most being about two-thirds the size of adults. Especially large numbers of young birds were found in the inner Uyak Bay. The Kodiak Archipelago appears to be a major nursery and wintering grounds for murres in the Gulf of Alaska.

Common Murres were the most abundant and ubiquitous species found in the Kodiak Archipelago. Density indices in bays increased dramatically from a summer mean of about 2 B/km^2 in 1977 (Gould et al. 1978) to 22 B/km^2 in November 1979 and 70 B/km^2 in February 1980 (Table 17). Murres were abundant wherever we went, being found on over 80% of all bay transects and over 50% of all offshore transects (Tables 5, 13-14). Large flocks were found in most bays (Figures 10-16) with the notable exceptions of Alitak and Chiniak Bays.

An exceptional aggregation of 125,000-130,000 murres was found in the Sitkalidak Strait area. Irving Warner (personal communication) estimated that hundreds of thousands and possibly over 1 million murres moved into the strait during a severe storm in January, and Jeff Allen (personal communication) found them extremely abundant there from early January through February. The major concentration of individuals remained along the 100 m isobath (Figure 15) although many of these birds moved into and out of local areas on a daily basis.

Over the continental shelf, murres generally occurred in flocks of less than 5, but groups of 10-20 were not uncommon. Two sizeable concentrations were encountered (Figures 17-18); the first was about 100 km east of Cape Chiniak over the shelfbreak and numbered about 165 birds. The largest was just south of Ugak Island and numbered over 1,300 birds. Many of these birds were rafting in remarkably straight lines paralleling the shore, perhaps foraging along lines of converging currents. Thousands of small fish were observed shoaling at the surface in these areas, probably providing an abundant food source.

There appeared to be movement out of bays in the evening and into bays in the morning, but our observations were inconclusive because bad weather hampered our observations. An early morning collection of five Common Murres had empty stomachs, whereas a 10 A.M. collection of six birds contained freshly caught Capelin in all of the stomachs. Irving Warner (personal communication) reported very large incidental catches of Capelin during January shrimp surveys in eastern Sitkalidak. These fish are apparently a major component in the diet of murres wintering around Kodiak.

Jeff Allen (personal communication), a local crab fisherman, reported catching an average of four murres per day while fishing 90 crab pots at a depth of 110-130 m in Sitkalidak Strait. These are the deepest murre diving depths we know of and they permit a great deal of speculation on the feeding habits and distributions of this species. The maximum depth of Sitkalidak Strait is about 136 m and murres were distributed throughout the area. In Uyak Bay however, mid-bay and outer-bay waters are up to 225 m deep and the murres formed a horseshoe type distribution around the edge, avoiding the deepest waters.

Density indices from ship and aerial surveys in February indicate that more than one million murres may winter throughout the Kodiak region. If these are mostly Common Murres, as indicated in our surveys, the area may support a significant part of the population that nests in the Bering Sea and the Gulf of Alaska.

PIGEON GUILLEMOTS *(Cepphus columba)* were the most neritic of the alcids inhabiting the Kodiak Archipelago. They were spread rather thinly along the entire coastline. Areas of highest density were Sitkalidak Narrows, Ugak Strait, Whale Pass, and parts of Uyak Bay. Density indices from shipboard surveys (Table 17) indicate a probable maximum of 6,000-8,000 guillemots in the area.

MARBLED and KITTLITZ'S MURRELETS *(Brachyramphus marmoratus and B. brevirostris)* are combined in this report because they are difficult to differentiate in the field. Only Marbled Murrelets were positively identified, but Kittlitz's Murrelets are known to occur in the Kodiak area throughout the year. *Brachyramphus* murrelets were common in all bays but exceptionally large numbers were encountered in Afognak Strait in February (Figure 13). The estimated population size for bays, based on mean density indices (Table 17), would be about 8,000-10,000 for November and 15,000-20,000 for February. It was our impression, however, that high quality habitat in Afognak Strait was overrepresented on our February surveys and we believe that a more reasonable population estimate would be about 13,000.

ANCIENT MURRELETS *(Synthliboramphus antiquus)* were found in equally small numbers in both November and February (Table 17). The few birds seen were in Uyak Bay, Shelikof Strait, and the Marmot-Izhut Bay complex. At least 200-500 birds occur as winter visitors to this area.

A CASSIN'S AUKLET *(Ptychoramphus aleutica)* was seen in outer Sitkalidak Strait on 30 November. This species is undoubtedly much more common than our data indicate and we probably missed the major areas of concentration for the species. Such an area could be the shallow continental shelf around the Trinity Islands.

LEAST AUKLETS *(Aethia pusilla)* are uncommon visitors to the Kodiak Archipelago. A single bird was identified in Outer Uyak Bay on 11 November and at least three other small alcids probably this species were sighted in Uyak Bay in November.

CRESTED AUKLETS *(Aethia cristatella)* are strictly winter visitors to the Kodiak area. As was true with King Eiders, Crested Auklets in the Kodiak Archipelago are at the very eastern limit of their nonbreeding range, and their numbers apparently fluctuate widely from year to year. Eddy Packinneny, a 68-year resident of Larson Bay, told us that he has seen "sea quail" in huge numbers in Whale Pass and Uyak Bay although not in the last 5 or 6 years. We found 10,000-15,000 moving into the Viekoda Bay-Kupreanof Strait-Afognak Strait area on 17 November. We are not sure whether this represented a migratory influx into the region, or merely local movement, but less than 250 were found throughout north and east Kodiak 9 days earlier and the species did not become common in eastern bays until the end of November.

By February birds had left Sitkalidak Strait but were still common on the Shelikof Strait side of Kodiak especially in Viekoda and Spiridon Bays (Tables 13-14). Dick (1977) did not find them in Chiniak Bay until 8 January and his latest observation was 27 February. Total density indices dropped by 8 B/km^2 from November to February. Crested Auklets probably reached peak numbers in the Kodiak Archipelago in December-January when we estimate possibly 50,000 birds were wintering in the area. The estimated breeding population for the entire gulf is about 42,000 (Sowls et al. 1978) and possibly all of them winter in the Kodiak Archipelago. The Gulf population in November may be augmented in winter by birds from the Aleutian Islands and Bering Sea.

RHINOCEROS AUKLETS *(Cerorhinca monocerata)* are uncommon residents in the Kodiak area. We found two birds in Uyak Bay in November and one in Chiniak Bay in February.

HORNED PUFFINS *(Fratercula corniculata)* were common in Uyak and Uganik Bays but rare in other areas on the November cruise. Most of these birds were fledglings which had not yet departed for their normal winter quarters. Puffins were not sighted on shipboard surveys in February, but six were found on aerial surveys over the continental shelf. These data would indicate about 2,000 birds wintering over the Kodiak Shelf.

TUFTED PUFFINS *(Lunda cirrhata)* were fewer in bays but more abundant in offshore waters than Horned Puffins. As was true with Horned Puffins, most Tufted Puffins in bays were immatures and concentrated in Uganik and Uyak Bays (Table 15). Seventeen birds were observed during offshore surveys in February, with highest density indices occurring in oceanic habitat (Table 5). We estimate 2,500-3,000 birds winter over the Kodiak Shelf, and only an exceptional bird in Kodiak bays.

MARINE MAMMALS

GRAY WHALES *(Eschrichtius robustus)* were found between 13 November-4 December and between 3-9 March (Table 18). The individual on 13 November was in Uganik Bay and two were seen in March on succeeding days in Marmot Bay. The remaining whales, including two groups of six, were found over middle Albatross Bank from Cape Chiniak to Sitkalidak Strait.

FIN WHALES *(Balaenoptera physalus)* were recorded only once. A single animal was observed on 1 March in Uganik Bay.

BEAKED WHALES (species unknown) were recorded only once. One animal was observed in Kaiugnak Bay on 30 November. The animal was about 6 m long with a small falcate dorsal fin located far back near the tail. The animal had white below the beak tipped head.

KILLER WHALES *(Orcinus orca)* were not found in November but three pods were found in February: 10 whales in Shelikof Strait, 10 outside of Chiniak Bay, and 20 near Ugak Island.

HARBOR POPRPOISES *(Phocoena phocoena)* were probably much more abundant than our observations indicate. We found 9 animals on 368 transects in November and 24 on 499 transects in February.

DALL'S PORPOISES *(Phocoenoides dalli)* were moderately common in the area. We counted 40 on 368 transects in November but only 20 on 499 transects in February.

STELLER'S SEA LION *(Eumetopias jubatus)* were seen in large numbers in the coastal surveys. Largest numbers were near Cape

Barnabas, Gurney Bay, and north of the Karluk River. A total of 2,411 was counted on the survey (Table 9).

HARBOR SEALS *(Phoca vitulina)* were common with a total of 337 found on coastal surveys (Table 9). The largest single group was 200 animals on the mud in Sukhoi Bay north of Alitak.

NORTHERN FUR SEALS *(Callorhinus ursinus)* were rare and probably accidental in the area during the winter. One very young and skinny individual was observed in Uganik Bay on 25 February. On two occasions this winter, young and underweight Fur Seals have been caught in fishing nets and turned over to the Kodiak National Wildlife Refuge.

SEA OTTERS *(Enhydra lutris)* were common north of Uganik Island, on the west and north of Spruce Island, and on the east side of Kodiak Island. One otter was found in western Sitkalidak Strait on 30 November.

DISCUSSION

OFFSHORE

Surveys of the continental shelf, shelfbreak, and oceanic habitats were conducted primarily from a large plane in mid-February. We identified 14 species or species groups of marine birds on these surveys (Tables 5-7). Density indices for shelfbreak and oceanic areas were identical but only one-third the value found for the continental shelf (Table 4). Except for three transects along the north side of Shelikof Strait, densities from continental shelf and shelfbreak waters in the Strait were only half those from similar areas south and east of Kodiak Island.

Murres and scoters were the most abundant species in continental shelf waters, making up 63% and 24%, respectively, of all birds seen (Table 5). Scoters occurred on only 5% of transects over the shelf, but their relative abundance was inflated by a concentration estimated at 3,600 birds near Tugidak Island. Lesser numbers of eiders were usually found with the scoters. A large concentration of about 1,300 murres was encountered on the shelf south of Ugak Island. These birds may have been part of the large assemblage encountered near Sitkalidak Strait on the inshore surveys. Although this concentration largely contributed to high murre densities on the shelf, murres were much more ubiquitous than scoters, occurring on 76% of all transects over the shelf. Glaucous-winged Gulls were also quite widespread over the shelf, occurring on a third of the transects but in very low numbers (Table 6).

Species composition changed farther offshore. Over the shelfbreak, fulmars and kittiwakes became the most abundant species. The average density of murres dropped sharply although they still occurred on 30% of the transects (Table 5). One flock of 165 murres was encountered over the shelfbreak, about 90 km east of Cape Chiniak. Nearshore species such as cormorants, sea ducks, and Mew Gulls were largely absent from these deeper waters. Densities of Glaucous-winged Gulls remained fairly constant.

The species composition found in oceanic waters was also different; densities of fulmars and kittiwakes decreased slightly, but there was a dramatic increase in the number of Fork-tailed Storm-petrels (Table 5). Numbers of shearwaters, murres, and Tufted Puffins also increased, but Glaucous-winged Gulls were not found.

The largest concentrations of birds were encountered in waters close to land (Figures 17-18). Birds found further offshore generally were in small flocks or very large aggregations, and densities declined. Only 17% of all transects conducted over these offshore waters had no birds recorded. Several species, particularly shearwaters, storm-petrels, and puffins, were observed offshore in numbers greater than expected. Murres appeared to be the most abundant and ubiquitous of all species.

BAYS

Surveys of bay areas were conducted from a small ship in November-December and February-March. Mean densities of seabirds increased dramatically from November to February (Table 17) with both periods having higher numbers than were found on similarly conducted cruises in the summer of 1977 (Gould et al. 1978). The increase from November to February was reflected in all major bay systems with the exception of Chiniak Bay which showed a slight decrease (Tables 11-12). The most significant increases in density were in Uyak Bay and eastern Sitkalidak Strait. The number of species and species groups, however, decreased from 42 in November to 35 in February reflecting primarily the end of migration and the departure of summer visitors (Tables 15-16).

Highest densities of seabirds, both in November and February, were found in the Whale Pass-Afognak Strait area. Lowest densities in both months were found in the Marmot Bay-Izhut Bay area. Moderate and basically similar densities were found in all other bays with the exception of eastern Sitkalidak Strait in February (Figures 19-21). The presence of a large concentration of murres in this latter area resulted in a density nearly equal to that found in the Whale Pass-Afognak Strait area (Tables 11-12).

Common Murres, Oldsquaws, Crested Auklets, White-winged Scoters, and Black Scoters, in that order, were the numerically dominant species wintering in bays throughout the Kodiak Archipelago. Their distributions tended to cover the entire area but we found several instances of extreme clumping in a number of species. Sea ducks, except for extremely large numbers of Oldsquaw in eastern Sitkalidak Strait, were found in equally high densities in north and south bays and relatively low densities in eastern bays. Alcids showed a similar but less pronounced trend. Exceptional numbers of murres were found in eastern Sitkalidak Strait in February and Whale Pass had relatively high densities of Crested Auklets in November. Gulls and cormorants were very uniform in their distributions.

ESTUARIES, LAGOONS, AND COASTAL AREAS

Surveys were conducted in a small plane along the entire coastline of Sitkalidak, Kodiak, and southeast Afognak Islands in February. One marine mammal and 29 marine birds were found per kilometer of coastline (Table 9). Black Scoters were the most abundant species observed on these surveys with Mallards, Oldsquaws, and Harlequin Ducks the next most abundant birds. Highest densities were found along the coastal fringes of Chiniak and Alitak Bays, and lowest densities were found in Marmot Bay (Table 10). Areas of greatest importance to the primary species groups were Uyak and Alitak Bays for puddle ducks; Olga and Alitak Bays for goldeneyes; Chiniak and Ugak Bays for scoters; Chiniak Bay for eiders; and the entire southern coast, especially along Sitkalidak Island, for Bald Eagles.

CONCLUSIONS

We estimate that the number of seabirds wintering over waters surrounding Kodiak Island is over 1,500,000 (Table 19), somewhat lower than the 2,300,000 estimated to occupy these waters in the summer.

Common Murres were, without question, the most abundant wintering seabird in the area. The entire Kodiak Archipelago probably represents a major nursery and wintering area for the northern and western Gulf population of this species, and also possibly for some Bering Sea murres. The major concentration was found in Eastern Sitkalidak Strait, although large numbers were present in most bays.

Shearwaters, puffins, and kittiwakes were numerically dominant in summer, whereas murres and sea ducks were the most abundant species in the winter.

Migration was still in progress in November. Some summer visitors such as kittiwakes and puffins had not yet left the bays and waterfowl such as Oldsquaw and Black Scoters were still moving in.

March appeared to be the beginning of spring migration although kittiwakes may return to rookeries as early as late February.

Prime habitats for seabirds wintering in the Kodiak area include ice-free estuaries and lagoons for puddle ducks, marine waters less than 25 m deep with rock and boulder substrates for seaducks, and waters near the 100 m isobath in midbay areas for alcids and other waterbirds.

Although we have little in the way of hard evidence, it seems correct to suggest that the extensive and complex system of bays and fjords in the Kodiak Archipelago are very important to many species of seabirds for short-term protection from storms and for relatively calm or safe resting sites between foraging expeditions. Such protected areas may be critical for species such as Common Murres and Crested Auklets during severe winters.

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Table 1. Aerial surveys of marine birds over the continental shelf, shelfbreak, and oceanic regions of the Kodiak Archipelago, 16-17 February 1980

Location	Area (Km^2)	10-Minute Transects	Transects Completed (KM^2)	% of area Surveyed
Kodiak Island				
Bays	3,545	14	16.1	0.5
Shelf	50,337	75	108.7	0.2
(Pacific)	43,291	71	101.9	0.2
(Shelikof)	7,046	4	6.8	0.1
Shelfbreak	24,298	33	45.3	0.2
(Pacific)	17,653	26	35.7	0.2
(Shelikof)	6,645	7	9.6	0.1
Oceanic	-	24	31.6	-
Alaska Peninsula				
Bays	-	2	2.9	-
Shelf	-	3	3.1	-
Total	-	151	207.6	-

Table 2. Shipboard surveys of marine birds around Sitkalidak, Kodiak, and southeastern Afognak Islands, and associated islets, November-December 1979

Survey Area	Open Bay and Shelf Waters			Estuary and Lagoon Waters		
	Area (KM^2)	10-Minute Transects	Transects Completed (KM^2)	% Of Area Surveyed	Area (KM^2)	Small Boat Surveys
Uyak Bay	305	70	58.0	19.0	20	2
Uganik Bay	277	60	50.4	18.2	14	5
Kupreanof Strait Viekoda Bay	302	15	12.5	4.1	6	0
Whale Passage-Afognak Strait	82	16	13.3	16.6	0	0
Izhut Bay-Marmot Bay	930	47	38.3	3.2	24.5	2
Chiniak Bay	253	20	16.7	6.6	10	0
Eastern Sitkalidak Strait-Kiliuda Bay	287	56	45.5	15.9	9	7
Western Sitkalidak Strait	327	48	38.3	11.7	12	4
Narrow Cape	32	5	4.2	13.1	0	0
Alitak Bay	593	0	0	0	14	0
Ugak Bay	157	0	0	0	7	0
Total Bays	3345	337	277.2	7.8	116.5	20
Inner Continental Shelf <100 m						
Pacific Ocean	N/A	19	15.8	N/A	N/A	0
Shelikof Strait	N/A	6	4.2	N/A	N/A	0
Outer Continental Shelf >100 m						
Shelikof Strait	N/A	6	4.9	N/A	N/A	0

Table 3. Shipboard surveys of marine birds around Sitkalidak, Kodiak, and southeastern Afognak Islands, and associated islets, February-March 1980

Survey Area	Open Bay and Shelf Waters			Estuary and Lagoon Waters		
	Area (KM^2)	10-Minute Transects	Transects Completed (KM^2)	% Of Area Surveyed	Area (KM^2)	Small Boat Surveys
Uyak Bay	305	71	59.2	19.4	20	3
Uganik Bay	277	63	52.5	19.0	14	4
Kupreanof Strait-Viekoda Bay	302	35	29.2	9.7	6	1
Whale Passage-Afognak Strait	82	27	19.5	23.8	0	0
Izhut Bay-Marmot Bay	930	93	76.0	8.2	24.5	3
Chiniak Bay	253	48	39.2	15.5	10	0
Eastern Sitkalidak Strait-Kiliuda Bay	287	57	47.5	16.5	9	6
Western Sitkalidak Strait	327	53	44.2	13.5	12	8
Narrow Cape	32	3	2.5	7.8	0	0
Alitak Bay	593	0	0	0	14	0
Ugak Bay	157	0	0	0	7	0
Total Bays	3545	450	369.8	10.4	116.5	25
Inner Continental Shelf <100 m						
Pacific Ocean	N/A	16	13.5	N/A	N/A	0
Shelikof Strait	N/A	21	16.0	N/A	N/A	0
Outer Continental Shelf >100 m	N/A	12	8.9	N/A	N/A	0

Table 4. Mean transect density indices of birds from aerial surveys of the Kodiak Archipelago, February 1980

Survey Area	Birds	Transects	Transect Density Index (B/Km^2) Mean	±	S.E.
Kodiak Basin					
Bays	2,005	45	148.21	±	100.92
Shelf	2,761	75	22.78	±	7.81
Pacific	2,670	71	23.40	±	8.23
Shelikof	91	4	11.70	±	8.49
Shelfbreak	309	33	7.27	±	2.49
Pacific	249	26	7.94	±	2.97
Shelikof	60	7	4.75	±	4.35
Oceanic	233	24	7.23	±	1.60
Alaska Peninsula					
Bays	91	2	27.44	±	14.68
Shelf	2,056	3	655.88	±	210.80

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Table 5. Frequency of occurrence[a] and relative density indices[b] of marine birds observed in offshore waters during aerial surveys of the Kodiak Archipelago, February 1980

Species	Continental Shelf		Shelfbreak		Oceanic	
	Density	Frequency	Density	Frequency	Density	Frequency
Shearwaters	0.01	1.33	0.09	9.09	0.24	16.67
Northern Fulmar	0.01	1.33	3.01	54.55	1.60	62.50
Fork-tailed Storm-petrel	0.04	1.33	0.05	3.03	1.81	53.33
Leach's Storm-petrel	-	-	0.02	3.03	0.03	4.17
Cormorants	0.42	8.00	0.02	3.03	-	-
Oldsquaw	0.13	4.00	-	-	-	-
Eiders	1.35	5.33	-	-	-	-
Scoters	5.41	5.33	-	-	-	-
Glaucous-winged Gull	0.87	34.67	0.87	18.18	-	-
Mew Gull	0.07	5.33	-	-	-	-
Black-legged Kittiwake	0.32	20.00	2.05	33.33	1.36	29.17
Murres	13.97	73.33	0.99	30.30	2.12	50.00
Horned Puffin	0.04	5.33	-	-	-	-
Tufted Puffin	0.01	1.33	0.09	9.09	1.08	25.00
Unidentified Alcids	0.13	9.33	0.07	3.03	0.56	8.33
Mean Density	22.78		7.27		7.94	
Total Birds	2761		309		233	
Total Transects		75		33	24	

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[a] Frequency of occurrence is the percent of transects on which the species was observed.

[b] Relative density is the mean transect density for total birds times the relative abundance of each species.

Table 6. Frequency of occurrence[a] of marine birds observed in aerial surveys of the Kodiak Archipelago, February 1980

Species		Pacific Ocean			Shelikof Strait		Alaska Peninsula	
	Kodiak Bays	Cont. Shelf	Shelf-Break	Oceanic	Cont. Shelf	Shelf-Break	Bays	Cont. Shelf
Loons	-	-	-	-	-	-	50.0	-
Northern Fulmar	-	1.4	65.4	62.5	-	14.3	-	-
Shearwaters	-	1.4	11.5	16.7	-	-	-	-
Fork-tailed Storm-petrel	-	1.4	3.8	58.3	-	-	-	-
Leach's Storm-petrel	-	-	3.8	4.2	-	-	-	-
Cormorants	50.0	7.0	3.8	-	25.0	-	-	66.7
Mallard	7.1	-	-	-	-	-	-	-
Common Goldeneye	7.1	-	-	-	-	-	-	-
Oldsquaw	14.3	2.8	-	-	25.0	-	50.0	66.7
Eiders	14.3	4.2	-	-	25.0	-	50.0	66.7
Scoters	35.7	4.2	-	-	25.0	-	100.0	100.0
Mergansers	7.1	-	-	-	-	-	-	-
Rock Sandpiper	7.1	-	-	-	-	-	-	-
Glaucous-winged Gull	57.1	33.8	15.4	-	50.0	28.6	100.0	66.7
Mew Gull	21.4	5.6	-	-	-	-	-	33.3
Black-legged Kittiwake	14.3	19.7	42.3	29.2	25.0	-	-	-
Murres	64.3	76.1	34.6	50.0	25.0	14.3	50.0	33.3
Horned Puffin	7.1	4.2	-	-	25.0	-	-	-
Tufted Puffin	7.1	1.4	11.5	25.0	-	-	-	-
Unidentified Alcids	-	9.9	3.8	8.3	-	-	-	-
Total No. Transects	14	71	26	24	4	7	2	3

[a] Frequency of occurrence is the percent of transects on which the species was observed.

Table 7. Relative abundance[a] of marine birds observed in aerial surveys of the Kodiak Archipelago, February 1980

Species		Pacific Ocean			Shelikof Strait		Alaska Peninsula	
	Kodiak Bays	Cont. Shelf	Shelf-Break	Oceanic	Cont. Shelf	Shelf-Break	Bays	Cont. Shelf
Loons	-	-	-	-	-	-	1.10	-
Northern Fulmars	-	0.04	28.92	19.74	-	93.33	-	-
Shearwaters	-	0.04	1.61	3.00	-	-	-	-
Fork-tailed Storm-petrel	-	0.19	0.80	22.32	-	-	-	-
Leach's Storm-petrel	-	-	0.40	0.43	-	-	-	-
Cormorants	6.78	0.52	0.40	-	40.66	-	-	0.44
Mallard	0.05	-	-	-	-	-	-	-
Common Goldeneye	0.10	-	-	-	-	-	-	-
Oldsquaw	2.00	0.41	-	-	5.50	-	4.40	3.94
Eiders	0.55	5.69	-	-	12.09	-	21.98	1.08
Scoters	77.51	24.38	-	-	5.49	-	59.34	84.09
Mergansers	3.89	-	-	-	-	-	-	-
Rock Sandpiper	1.50	-	-	-	-	-	-	-
Glaucous-winged Gull	3.54	3.03	14.06	-	27.47	3.33	12.09	0.44
Mew Gull	0.15	0.30	-	-	-	-	-	0.05
Black-legged Kittiwake	0.10	1.39	34.94	16.74	2.20	-	-	-
Murres	3.74	63.22	16.06	26.18	5.49	3.33	1.10	0.24
Horned Puffin	0.05	0.15	-	-	1.10	-	-	-
Tufted Puffin	0.05	0.04	1.61	4.72	-	-	-	-
Unidentified Alcids	-	0.60	1.20	6.87	-	-	-	-
Total No. Birds	2005	2670	249	233	91	60	91	2056

[a] Relative abundance is the percent of the total birds.

Table 8. Waterfowl counts made by biologists of the Kodiak National Wildlife Refuge and Alaska Department of Fish and Game in nearshore and estuarine areas of Kodiak Island. Adapted from data on file with the Kodiak National Wildlife Refuge and from Dick (1977)

Date (Mo-Yr)	11-66	11-72	01-66	01-72	01-73	02-66	02-72	02-75	03-66	03-69	03-77	04-66	04-76
Area	NW	Misc.	NE	NE	All	NW	SW	All	NW	All	All	NW	Chiniak
Kilometers	?	?	?	?	1387	180	?	959	?	?	1403	180	?
Platform	Plane	Plane	Plane	Plane	Ship	Plane	Plane	Ship	Plane	Plane	Plane	Plane	Plane
Swan	42	-	-	-	-	-	-	-	-	-	-	34	+
Emperor Goose	-	770	-	98	621	-	90	52	-	750	113	-	200
White-fronted Goose	-	-	-	-	-	-	-	-	-	-	-	-	+
Black Brant	-	-	-	-	-	-	-	-	-	-	-	-	200+
Mallard	1412	3298	2448	1068	700	1140	447	2556	1576	2864	3512	4533	+
Gadwall	-	-	-	-	30	-	-	75	-	-	12	2562	-
Pintail	-	882	2	-	200	-	-	4	-	75	-	-	4500
Green-winged Teal	-	601	-	-	-	-	-	-	-	-	1	-	+
American Widgeon	-	371	-	-	-	-	-	-	-	60	90	550	200+
Shoveler	-	-	-	-	-	-	-	-	-	-	-	-	12
Scaup	-	-	150	-	80	8	-	15	10	-	700	100	+
Common Goldeneye	-	-	-	-	146	-	-	-	-	-	-	-	+
Barrow's Goldeneye	-	-	-	-	24	-	-	30	-	-	-	-	+
Unid. Goldeneye	553	-	613	272	1142	323	86	1205	1001	-	2025	1772	-
Bufflehead	100	-	99	-	36	29	-	27	30	-	403	-	+
Oldsquaw	-	-	158	1018	7863	126	1400	9410	213	-	1875	200	+
Harlequin Duck	522	-	-	370	691	33	-	675	70	-	1109	8	+
Steller's Eider	-	-	200	-	340	-	10	1176	-	-	677	-	+
Common Eider	-	-	-	-	4512	-	-	58	-	-	108	-	+
King Eider	-	-	-	-	-	-	-	4654	-	-	-	-	-
Unid. Eider	-	86	-	-	67	-	-	1745	-	-	-	-	-
White-winged Scoter	-	-	-	-	3059	-	-	2073	-	-	1764	-	+
Surf Scoter	-	-	-	-	1194	-	-	327	-	-	167	-	+
Black Scoter	-	-	-	-	2154	-	-	1402	-	-	1691	-	+
Unid. Scoter	-	343	330	344	3192	176	65	984	282	-	5987	140	-
Common Merganser	-	-	-	-	21	-	-	21	-	-	13	-	+
Red-breasted Merganser	-	-	-	-	13	-	-	34	-	-	10	-	+
Unid. Merganser	-	-	24	-	39	-	-	27	-	-	21	-	-

Table 9. Numbers of birds recorded in small plane surveys of nearshore waters of Kodiak, Sitkalidak, and southeast Afognak Islands, and associated islets, February - March 1980

Bay System	UY[a]	UG	VI	NM	SM	CH	UB	ES	WS	GA	AL	OL	SS	Totals	Birds/KM Coastline
KM of Coastline	341	337	237	201	217	170	122	213	327	199	274	94	204	2936	
Loons	1	11	1	1	1	5	2	4	7	3	-	1	4	41	0.014
Grebes	8	12	-	-	-	1	3	24	4	4	1	-	-	57	0.019
Cormorants	182	180	113	51	201	375	48	113	191	474	42	80	400	2450	0.834
Emperor Goose	-	-	-	-	-	195	-	-	6	208	-	-	221	630	0.214
Mallard	2673	275	117	3	2	219	74	852	446	960	1674	332	549	8176	2.785
Pintail	-	-	-	-	-	-	-	86	13	28	344	-	87	558	0.190
Green-wing Teal	-	4	-	-	-	-	2	70	31	39	-	2	4	152	0.052
American Widgeon	-	-	-	-	-	-	-	6	-	6	-	-	-	12	0.004
Gadwall	-	11	-	-	-	7	-	-	-	-	-	-	15	33	0.011
Unid. Puddle Duck	-	50	25	10	-	27	25	120	65	70	187	102	-	681	0.232
Total Puddle Ducks	2673	340	142	13	2	253	101	1134	555	1103	2205	436	655	9612	3.270
Greater Scaup	57	239	208	-	260	684	41	356	536	140	678	184	-	3383	1.152
Common Goldeneye	-	-	-	-	-	-	-	-	10	-	-	-	-	10	0.003
Barrow's Goldeneye	-	232	190	-	26	15	-	-	29	-	16	15	9	532	0.181
Unid. Goldeneye	658	56	891	145	21	214	186	265	322	303	2063	807	563	6494	2.212
Total Goldeneye	658	288	1081	145	47	229	186	265	361	303	2079	822	572	7036	2.396
Bufflehead	424	473	169	-	5	9	165	631	511	342	386	35	1	3151	1.073
Merganser-Goldeneye	41	409	64	-	12	5	28	30	46	98	159	32	20	944	0.321
Oldsquaw	419	808	590	41	188	404	248	820	120	566	154	111	978	5447	1.855
Harlequin Duck	416	264	217	18	106	455	235	770	723	306	922	403	96	4931	1.679
Steller's Eider	13	13	13	-	-	126	-	29	99	27	9	-	9	328	0.112
Common Eider	-	-	-	-	-	76	-	35	-	-	-	-	-	111	0.038
King Eider	-	-	-	-	300	864	-	38	-	414	237	-	-	1853	0.631
Unid. Eider	-	2	5	-	23	543	-	25	24	31	281	-	17	951	0.324
Total Eiders	13	15	8	-	323	1609	-	127	123	472	527	-	26	3243	1.105
White-winged Scoter	236	84	24	18	55	518	55	279	379	367	595	199	154	2963	1.009
Surf Scoter	322	233	73	10	90	98	237	141	107	201	174	42	115	1843	0.628
Black Scoter	1825	2361	694	44	677	2220	1968	1500	1480	1517	3693	126	1048	19153	6.523

Table 9. (Continued)

Bay System	UY[a]	UG	VI	NM	SM	CH	UB	ES	WS	CA	AL	OL	SS	Totals	Birds/Km Coastline
KM of Coastline	341	337	237	201	217	170	122	213	327	199	274	94	204	2936	
Unid. Scoter	506	857	386	62	205	737	297	275	225	286	731	366	362	5295	1.803
Total Scoters	2889	3535	1177	134	1027	3573	2557	2195	2191	2371	5193	733	1679	29254	9.964
Common Merganser	5	2	2	1	-	30	5	4	9	15	7	3	10	93	0.032
Red-breasted Merganser	32	5	-	-	-	-	-	6	108	-	7	-	2	160	0.054
Unid. Merganser	183	54	48	4	5	48	79	63	96	34	90	6	1	811	0.276
Total Mergansers	220	61	50	5	5	78	184	73	213	49	104	9	13	1064	0.362
Unid. Sea Duck	725	926	739	60	527	891	473	858	440	384	790	332	272	7417	2.526
Total Ducks-Geese	8535	7358	4445	416	2502	8385	4218	7259	5825	6342	13197	3097	4533	76112	25.923
Rock Sandpiper	-	-	-	-	-	-	-	-	25	80	250	-	-	355	0.121
Unid. Sandpiper	-	170	-	-	-	-	137	212	75	180	65	200	50	1089	0.371
Black Turnstone	-	-	-	-	-	-	-	-	100	10	-	-	-	110	0.097
Black Oystercatcher	-	-	-	-	-	200	-	-	110	10	-	-	-	320	0.109
Total Shorebirds	-	170	-	-	-	200	137	212	310	280	315	200	50	1874	0.638
Glaucous-winged Gull	12	10	11	3	14	4	10	44	7	241	8	2	38	404	0.138
Mew Gull	444	111	16	1	1	196	12	63	5	5	89	-	-	943	0.321
Larus Gull	580	30	37	53	25	78	3	54	32	210	112	6	103	1323	0.451
Unid. Gull	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Gulls	1036	151	64	57	40	278	25	161	44	501	209	8	141	2715	0.945
Crested Auklet	-	-	-	-	6	-	-	-	-	-	-	-	-	6	0.002
Black-legged Kittiwake	-	2	-	-	-	900	-	25	-	1	-	1	-	929	0.316
Unid. Murre	120	36	15	-	9	-	35	21	6	5	6	-	19	272	0.093
Pigeon Guillemot	22	22	15	5	6	4	3	12	3	4	3	2	15	116	0.039
Unid. Waterbird	98	21	29	52	3	10	44	23	8	4	8	48	24	412	0.140
Total Waterbirds	10002	7963	4682	582	2768	10158	4515	7854	6438	7573	13781	3437	5186	84939	28.930

Table 9. (concluded)

Bay System	UY[a]	UG	VI	NM	SM	CH	UB	ES	WS	CA	AL	OL	SS	Totals	Birds/Km Coastline
Km of Coastline	341	337	237	201	217	170	122	213	327	199	274	94	204	2936	
Bald Eagle (Adult)	54	21	13	15	15	35	5	44	54	56	37	6	-	355	0.121
Bald Eagle (Immature)	2	8	2	1	6	16	-	22	28	28	6	-	-	119	0.040
Bald Eagle (Age Unk.)	1	-	-	-	-	-	-	-	-	1	-	-	-	2	0.001
Northwestern Crow	164	457	281	128	40	-	66	30	78	40	123	-	-	1407	0.479
Total Birds	10223	8449	4978	726	2829	10209	4586	7950	6598	7698	13947	3443	5186	86822	29.572
Steller's Sealion	3	24	1	1	1	210	-	742	202	25	-	-	1202	2411	0.821
Sea Otter	2	70	40	2	-	5	-	-	1	-	-	-	-	120	0.041
Harbor Seal	-	4	-	-	-	-	60	13	9	34	-	-	217	337	0.115
Total Mammals	5	98	41	3	1	215	60	755	211	60	-	-	1419	2868	0.977

[a] UY=Uyak Bay, UG=Uganik Bay, VI=Viekoda Bay-Kurpreanof Strait, NM=Northern Marmot Bay, SM=Southern Marmot Bay, CH=Chiniak, UB=Ugak Bay, ES=Eastern Sitkalidak Strait, WS=Western Sitkalidak Strait, CA=Coastal Gulf of Alaska, AL=Alitak, OL=Olga Bay, SS=Coastal Shelikof Strait

Table 10. Density of major bird groups recorded in small plane surveys of nearshore waters of Sitkalidak, Kodiak, and southeast Afognak Islands, and associated islets, February 1980

Bay Systems	Km of Coast	Total Eagles	Puddle Ducks	Goldeneye Ducks	Scoter Ducks	Eider Ducks	Total Waterfowl	Total Waterbirds
Uyak Bay	341	0.17[a]	7.84	1.93	8.48	0.04	25.03	29.34
Uganik Bay	337	0.09	1.01	0.86	10.49	0.05	21.84	23.63
Viekoda Bay-Kupreanof St.	237	0.06	0.60	4.57	4.97	0.04	18.76	19.76
Northern Marmot Bay	201	0.08	0.07	0.73	0.67	0.00	2.07	2.90
Southern Marmot Bay	217	0.10	0.01	0.22	4.47	1.49	11.53	12.76
Chiniak Bay	170	0.30	1.49	1.35	21.02	9.47	49.33	59.75
Ugak Bay	122	0.04	0.83	1.53	20.96	0.00	34.58	37.01
Eastern Sitkalidak St.	213	0.31	5.33	1.25	10.31	0.60	34.08	36.88
Western Sitkalidak St.	327	0.25	1.70	1.11	6.70	0.38	17.82	19.69
Coastal Gulf of Alaska	199	0.43	5.55	1.53	11.92	2.38	31.87	38.06
Alitak Bay	274	0.16	8.05	7.59	18.96	1.93	48.70	50.30
Olga Bay	94	0.06	4.93	8.75	7.80	0.00	32.95	36.56
Coastal Shelikof St.	204	0.00	3.21	2.81	8.23	0.13	22.22	25.43

[a] Density: Birds Per Km of Coastline.

Table 11. Abundance of birds in major bay systems of Kodiak Island as derived from shipboard surveys, November-December 1979

Survey Area	Birds/Km^2 In Transects Mean ± S.E.	Estimated Birds		
		Estuaries and and Lagoons	Bays	Survey Area
Uyak Bay	64.0 ± 8.0	3,900	19,500	23,400
Uganik Bay	84.5 ± 12.2	2,700	23,400	26,100
Viekoda Bay-Kupreanof Strait[a]	68.6 ± 25.5	No surveys	N/A[b]	N/A
Whale Pass-Afognak Strait	334.3 ± 124.3	No surveys	27,400	28,000
Izhut Bay-Marmot Bay[a]	41.0 ± 5.0	No surveys	38,100	39,000
Chiniak Bay[a]	81.3 ± 28.6	No surveys	20,600	22,000
Eastern Sitkalidak Strait-Kiliuda Bay	64.7 ± 10.6	1,500	18,600	20,100
Western Sitkalidak Strait	93.3 ± 23.3	3,600	30,500	34,100
Narrow Cape	101.8 ± 21.2	No surveys	N/A	N/A
Inner Continental Shelf <100 m				
Pacific Ocean	22.5 ± 6.3	N/A	N/A	N/A
Shelikof Strait	40.2 ± 10.8	N/A	N/A	N/A
Outer Continental Shelf <100 m				
Shelikof Strait	9.3 ± 2.6	N/A	N/A	N/A

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[a] Densities are strongly influenced by a few transects and are not representative of the entire area.

[b] N/A: Not applicable.

Table 12. Abundance of birds in major bay systems of Kodiak Island as derived from shipboard surveys, February-March 1980

Survey Area	Birds/Km^2	Estimated Birds		
	In Transects Mean ± S.E.	Estuaries and Lagoons	Bays	Survey Area
Uyak Bay	116.4 ± 12.7	5,000	36,000	41,000
Uganik Bay	109.5 ± 18.0	3,000	30,000	33,000
Viekoda Bay-Kupreanof Strait	99.5 ± 33.1	1,250	30,100	31,300
Whale Pass-Afognak Strait	370.8 ± 66.0	No surveys	30,400	30,400
Izhut Bay-Marmot Bay	53.4 ± 7.9	1,000	49,700	50,700
Chiniak Bay	76.5 ± 10.2	860	19,350	20,200
Eastern Sitkalidak Strait-Kiliuda Bay	436.4 ± 74.0	2,500	125,000	128,000
Western Sitkalidak Strait	110.8 ± 23.9	3,000	36,200	39,200
Narrow Cape	307.7 ± 128.6	No surveys	N/A[a]	N/A
Inner Continental Shelf <100 m				
Pacific Ocean	24.3 ± 4.7	N/A	N/A	N/A
Shelikof Strait	114.5 ± 15.6	N/A	N/A	N/A
Outer Continental Shelf >100 m				
Shelikof Strait	12.2 ± 3.3	N/A	N/A	N/A

[a] N/A: Not applicable.

Table 13. Frequency of occurrence (%) of seabirds recorded in shipboard surveys of Sitkalidak, Kodiak, and southeast Afognak Islands, and associated islets, November-December 1979

Survey Areas[a]	WS	ES	PO	UG	Total South	CB	MB	IB	WP	Total East	KS	UB	SS	UY	Total North	Total for All Areas
Number of Transects	48	56	19	5	128	20	30	17	16	83	18	57	12	70	157	368
Loons	21	16	21	40	20	5	10	0	6	6	17	12	0	31	20	17
Grebes	15	25	0	0	16	5	0	0	0	1	22	16	0	11	13	12
Cormorants	69	61	26	60	59	70	43	65	75	60	72	58	17	54	55	57
Puddle Ducks	0	0	0	0	0	0	0	0	6	1	0	4	0	0	1	1
Goldeneye Ducks	10	9	0	0	8	0	0	12	0	2	11	16	0	1	8	7
Oldsquaw	31	38	0	60	30	20	13	0	38	17	6	14	0	16	13	20
Harlequin Duck	8	25	0	0	14	10	10	18	25	14	28	28	0	23	24	18
Eiders	2	0	0	60	3	5	0	0	0	1	0	0	0	0	0	1
White-winged Scoter	15	23	5	99	20	20	13	12	25	17	28	25	0	13	18	18
Surf Scoter	13	5	0	0	7	0	0	12	0	2	6	11	0	10	9	7
Black Scoter	13	23	5	0	16	5	3	6	25	8	11	23	8	16	17	20
Scoters (total)	33	45	16	99	38	25	20	29	31	25	33	49	17	33	34	34
Mergansers	6	5	0	0	5	0	0	6	0	1	0	2	8	7	4	4
Glaucous-winged Gull	23	29	16	80	27	30	33	29	50	35	56	44	67	69	58	42
Mew Gull	54	48	26	60	48	20	57	59	25	42	50	42	17	23	32	40
Kittiwakes	63	25	5	0	35	10	23	0	44	19	44	60	58	67	61	43
Murres	88	73	84	40	79	90	97	88	50	84	99	98	99	99	99	89
Pigeon Guillemot	27	38	16	60	31	45	23	6	69	34	39	35	0	21	27	30
Murrelets	60	57	37	40	55	70	13	29	19	31	33	28	17	37	32	40
Crested Auklet	33	9	16	20	20	60	30	24	38	37	22	14	0	7	11	20
Puffins	4	2	0	0	2	0	0	6	6	2	28	42	25	29	33	15

[a] Areas - WS=Westerm Sitkalidak, ES=Eastern Sitkalidak, PO=Pacific Ocean, UG=Ugak Strait, CB=Chiniak Bay, MB=Marmot Bay, IB=Izhut Bay, WP=Whale Passage, KS=Kupreanof Strait, UB=Uganik Bay, SS=Shelikof Strait, UY=Uyak Bay.

Table 14. Frequency of occurrence (%) of seabirds recorded in shipboard surveys of Sitkalidak, Kodiak, and southeast Afognak Islands, and associated islets, February-March 1980

Survey Area[a]	WS	ES	PO	UG	Total South	CB	MB	IB	WP	Total East	KS	UB	SS	UY	Total North	Total For All Areas
Number of Transects	53	57	17	3	130	47	72	21	27	167	42	56	33	71	202	499
Loons	17	18	12	0	16	9	8	5	22	10	12	13	3	17	12	13
Grebes	34	16	0	67	22	15	4	24	15	11	17	21	9	28	21	18
Cormorants	53	61	47	99	57	77	71	76	89	76	67	66	36	66	61	65
Puddle Ducks	0	5	0	0	2	6	0	10	0	3	0	2	0	8	3	3
Goldeneye Ducks	15	18	0	0	14	13	7	24	7	11	19	32	0	30	23	17
Oldsquaw	40	32	0	67	32	55	28	33	81	45	19	36	27	32	29	35
Harlequin Duck	15	16	0	0	13	23	15	43	26	23	14	30	3	41	26	22
Eiders	9	19	6	67	15	32	8	0	59	22	0	2	3	0	1	12
White-winged Scoter	40	28	0	99	31	28	18	19	48	26	14	39	48	21	29	28
Surf Scoter	3	9	0	67	11	9	3	5	7	5	7	13	12	23	15	11
Black Scoter	30	21	0	0	22	34	8	10	52	23	19	30	6	31	24	23
Scoters (total)	49	42	0	99	41	40	25	24	70	37	33	57	48	49	48	42
Mergansers	8	7	0	67	8	4	4	14	11	7	19	18	3	20	16	11
Glaucous-winged Gull	42	56	71	33	52	60	43	29	22	43	31	43	67	45	45	46
Mew Gull	53	60	18	33	51	19	36	48	26	31	55	59	48	44	51	44
Kittiwakes	2	7	6	0	5	4	39	0	0	18	7	7	9	11	9	11
Murres	98	72	76	33	82	60	79	71	44	67	93	96	85	96	94	82
Pigeon Guillemot	26	26	18	99	27	60	38	29	93	51	50	52	42	51	50	44
Murrelets	68	40	53	67	54	66	65	52	70	65	60	45	21	76	55	58
Crested Auklet	0	0	0	0	0	6	6	5	44	12	19	9	21	28	20	12
Puffins	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[a] Areas - WS=Western Sitkalidak, ES=Eastern Sitkalidak, PO=Pacific Ocean, UG=Ugak Strait, CB=Chiniak Bay, MB=Marmot Bay, IB=Izhut Bay, WP=Whale Passage, KS=Kupreanof Strait, UB=Uganik Bay, SS=Shelikof Strait, UY=Uyak Bay.

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Table 15. Numbers of birds recorded in shipboard surveys of Sitkalidak, Kodiak, and southeast Afognak Islands, and associated islets, November 1979

Survey Area	UY[a]	UG	KV	WA	MI	CH	NA	ES	WS	IS	IP	OS	Total
Km^2 Surveyed	58.0	50.4	12.5	13.3	38.3	16.7	4.2	45.5	38.3	4.2	15.8	4.9	302.1
Common Loon	-	1	-	-	-	-	-	-	-	-	-	-	1
Yellow-billed Loon	-	-	-	-	-	-	-	1	-	-	2	-	3
Arctic Loon	2	-	-	-	-	-	-	-	-	-	-	-	2
Red-throated Loon	5	1	-	-	-	-	-	-	-	-	-	-	6
Unid. Loon	22	10	8	1	6	1	3	17	19	6	2	3	98
Red-necked Grebe	11	8	3	-	-	-	-	55	38	-	-	-	115
Horned Grebe	-	-	-	-	-	-	-	2	-	-	-	-	2
Unid. Grebe	1	6	1	-	-	1	-	7	-	-	-	-	16
Shearwater	-	-	-	-	-	-	-	-	1	-	-	1	2
Double-crested Cormorant	4	-	-	2	1	1	-	2	-	-	-	-	10
Pelagic/Red-faced Corm.	184	167	57	181	89	115	11	409	334	1	33	1	1582
Emperor Goose	2	-	-	-	-	-	-	-	-	-	-	-	2
Unid. Puddle Duck	-	2	-	-	-	-	-	-	-	-	-	-	2
Mallard	-	4	-	30	-	-	-	-	-	-	-	-	34
Pintail	-	-	-	-	-	-	-	-	-	-	-	-	0
Green-winged Teal	-	-	-	-	-	-	-	-	-	-	-	-	0
American Widgeon	-	-	-	-	-	-	-	-	-	-	-	-	0
Gadwall	-	-	-	-	-	-	-	-	-	-	-	-	0
Greater Scaup	-	-	-	-	-	-	-	-	98	-	-	-	98
Common Goldeneye	-	-	-	-	-	-	-	2	10	-	-	-	12
Barrow's Goldeneye	42	266	-	-	54	-	-	-	-	-	-	-	362
Unid. Goldeneye	-	-	-	-	-	-	-	-	3	-	-	-	3
Bufflehead	8	8	-	-	-	-	-	62	4	-	-	-	82
Oldsquaw	397	27	8	13	82	20	65	2374	111	-	-	-	3097
Harlequin Duck	105	103	17	44	30	33	-	326	20	-	-	-	678
Common Eider	-	-	-	-	-	-	-	-	-	-	-	-	0
King Eider	-	-	-	-	-	-	-	-	-	-	-	-	0
Somateria sp.	-	-	-	-	-	7	5	-	1	-	-	-	13
Steller's Eider	-	-	-	-	-	-	17	-	-	-	-	-	17
White-winged Scoter	185	125	246	463	88	43	240	221	104	-	6	-	1721
Surf Scoter	30	68	-	-	3	-	-	27	45	-	-	-	173
Black Scoter	173	251	5	130	4	1	-	202	240	1	2	-	1009
Unid. Scoter	65	18	-	-	8	12	-	17	66	1	15	-	202
Common Merganser	2	-	-	-	-	-	-	-	-	-	-	-	2
Red-breasted Merganser	11	-	-	-	8	-	-	6	2	1	-	-	28
Unid. Merganser	-	4	-	-	-	-	-	13	6	-	-	-	23
Unid. Sea Duck	12	3	-	-	-	-	8	53	-	-	-	-	76
Bald Eagle	1	1	2	3	-	-	-	1	1	-	-	-	9
Peregrine Falcon	-	-	-	1	-	-	-	-	-	-	-	-	1
Rock Sandpiper	-	-	-	-	-	-	-	-	-	-	-	-	0
Black Oystercatcher	-	-	-	-	-	-	-	-	-	-	-	-	0
Unid. Shorebirds	-	35	-	-	-	-	-	-	-	-	-	-	35
Northern Phalarope	1	-	-	-	1	-	-	-	-	-	-	-	2
Unid. Phalarope	5	-	-	-	-	-	-	-	-	-	-	-	5
Glaucous Gull	-	-	-	-	-	-	-	-	2	-	-	-	2
Glaucous-winged Gull	206	42	46	16	33	10	11	43	15	5	3	4	434
Herring Gull	2	-	-	-	-	-	-	-	-	-	-	-	2
Mew Gull	20	85	12	60	88	7	3	60	124	3	6	-	468
Unid. *Larus* Gull	1	8	-	-	4	3	-	1	1	0	2	-	20
Black-legged Kittiwake	454	314	23	28	26	3	-	236	886	68	1	1	2040
Common Murre	569	89	46	148	69	16	1	44	44	4	7	-	1037
Thick-billed Murre	6	3	3	1	2	-	-	-	2	2	-	2	21
Unid. Murre	1072	2141	229	33	713	128	5	121	940	72	134	47	5635
Pigeon Guillemot	50	37	9	136	43	21	47	98	52	-	14	-	507
Marbled Murrelet	5	57	10	2	5	18	3	59	37	1	1	-	198
Unid. *Brachyramphus* Murl.	79	4	14	13	22	132	1	61	140	-	32	-	498
Ancient Murrelet	6	-	-	-	6	-	-	-	-	-	-	-	12
Crested Auklet	8	224	145	3121	152	747	4	178	192	-	90	-	4861
Least Auklet	1	-	-	-	-	-	-	-	-	-	-	-	1
Parakeet Auklet	-	-	-	-	-	-	-	-	-	-	-	-	0
Cassin's Auklet	-	-	-	-	-	-	-	-	1	-	-	-	1
Rhinocerous Auklet	1	-	-	-	-	-	-	-	-	-	-	-	1
Horned Puffin	19	35	1	-	1	-	-	1	1	1	-	-	59
Tufted Puffin	14	15	3	-	1	-	-	1	1	2	-	-	37
Unid. large Alcid	2	2	-	-	15	-	-	-	-	2	6	-	27
Unid. small Alcid	9	8	-	-	2	36	-	1	8	-	-	-	64
Belted Kingfisher	-	-	-	-	1	-	-	-	-	-	-	-	1
Black-billed Magpie	1	-	-	-	-	-	-	-	-	-	-	-	1
Common Raven	-	-	-	-	-	-	-	-	-	-	-	-	0
Northwestern Crow	-	8	-	-	-	-	-	-	-	-	-	-	8
Unid. Bird	-	1	-	-	3	-	-	-	-	-	-	-	4
Total Birds	3793	4181	888	4426	1560	1355	424	4701	3549	170	356	59	25462

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[a] UY=Uyak Bay; UG=Ugenik Bay; KV=Kupreanof Strait - Viekoda Bay; WA=Whale Pass-Afognak Strait; MI=Marmot Bay-Izhut Bay; CH=Chiniak Bay; NA= Narrow Strait; ES=Eastern Sitkalidak Strait; WS=Western Sitkalidak Strait; IS=Inner Shelikof Strait Shelf; IP=Inner Pacific Shelf; OS=Outer Shelikof Strait Shelf

Table 16. Numbers of birds recorded in shipboard surveys of Sitkalidak, Kodiak, and southeast Afognak Islands, and associated islets, February 1980

Survey Area	UT[a]	UG	KV	WA	MI	CH	NA	ES	WS	IS	IP	OS	Total
KM^2 Surveyed	59.2	52.5	29.2	19.5	76.0	39.2	2.5	47.5	44.2	16.0	13.5	8.9	408.2
Common Loon	-	31	-	-	-	-	-	-	1	-	-	-	32
Yellow-billed Loon	1	1	-	-	-	1	-	1	-	-	-	-	4
Unid. Loon	23	12	5	7	4	3	-	10	12	4	-	2	82
Red-necked Grebe	50	10	11	7	10	4	7	18	55	2	-	3	177
Horned Grebe	-	11	8	-	-	6	-	2	16	-	-	-	43
Unid. Grebe	9	5	1	-	-	7	-	1	4	1	-	-	28
Shearwater	-	-	-	-	-	-	-	-	-	-	-	-	0
Double-crested Cormorant	-	-	-	-	1	1	-	-	1	-	-	-	3
Pelagic/Red-faced Corm.	240	197	166	242	349	194	-	271	150	145	-	90	2044
Emperor Goose	-	-	-	-	-	-	-	-	-	-	-	-	0
Unid. Puddle Duck	4	-	-	-	-	-	-	27	-	-	-	-	31
Mallard	42	-	-	-	25	13	-	3	-	-	-	-	83
Pintail	-	-	-	-	-	-	-	-	-	-	-	-	0
Green-winged Teal	-	-	-	-	-	-	-	-	-	-	-	-	0
American Widgeon	-	1	-	-	4	-	-	-	-	-	-	-	5
Gadwall	5	-	-	-	-	4	-	-	-	-	-	-	9
Greater Scaup	161	-	16	3	1	1	-	69	7	-	-	-	258
Common Goldeneye	6	22	16	-	-	-	-	3	-	-	-	-	47
Barrow's Goldeneye	82	42	19	1	88	1	-	1	4	-	-	-	238
Unid. Goldeneye	89	102	36	12	18	18	-	21	11	-	-	-	307
Bufflehead	19	8	1	-	16	-	-	25	38	-	-	-	107
Old Squaw	758	690	627	1613	180	1029	11	1271	1152	232	-	-	7563
Harlequin Duck	276	122	50	46	85	190	-	115	154	13	-	-	1051
Common Eider	-	-	-	-	-	2	-	2	-	-	-	-	4
King Eider	-	-	-	541	11	31	311	61	10	1	-	12	978
Somateria sp.	-	23	-	60	183	183	-	38	20	-	-	-	507
Steller's Eider	1	-	-	-	-	106	-	2	5	-	-	-	114
White-winged Scoter	313	644	214	321	78	135	357	228	162	447	-	-	2899
Surf Scoter	140	29	7	4	16	23	19	12	97	72	-	-	419
Black Scoter	508	202	43	1230	12	294	-	158	161	103	-	-	2711
Unid. Scoter	153	28	12	503	9	39	-	13	7	-	-	-	764
Common Merganser	7	3	15	-	4	1	-	3	1	1	-	-	35
Red-breasted Merganser	23	22	6	5	5	7	20	8	8	-	-	-	104
Unid. Merganser	15	10	-	2	1	-	-	11	-	-	-	-	39
Unid. Sea Ducks	-	5	-	36	-	9	-	3	2	-	-	-	55
Bald Eagle	8	3	1	1	1	-	-	2	-	-	-	-	16
Peregrine Falcon	-	-	-	-	-	-	-	-	-	-	-	-	0
Rock Sandpiper	-	-	-	-	-	-	-	-	-	32	-	-	32
Black Oystercatchers	2	-	-	-	-	-	-	-	-	-	-	-	2
Unid. Shorebirds	30	-	-	-	-	-	-	-	-	-	-	-	30
Northern Phalarope	-	-	-	-	-	-	-	-	-	-	-	-	0
Unid. Phalarope	-	-	-	-	-	-	-	-	-	-	-	-	0
Glaucous Gull	-	-	-	-	-	-	-	-	-	-	-	-	0
Glaucous-winged Gull	78	165	34	13	55	57	5	150	53	42	24	56	732
Herring Gull	-	-	-	-	1	-	-	-	-	-	-	-	1
Mew Gull	56	160	44	10	81	10	2	302	83	49	18	17	832
Unid. *Larus* Gull	1	-	-	1	8	2	-	32	9	1	1	5	60
Black-legged Kittiwake	15	8	3	-	57	151	-	5	4	3	2	-	248
Common Murre	44	114	17	20	24	25	-	-	46	-	-	7	297
Thick-billed Murre	-	-	-	-	1	4	-	-	-	5	-	2	12
Unid. Murre	2340	2030	990	774	568	207	2	17691	2318	369	57	100	27446
Pigeon Guillemot	124	94	60	233	36	111	32	48	42	35	-	8	823
Marbled Murrelet	75	42	90	447	101	42	-	12	64	1	-	-	874
Unid. *Brachyramphus* Murl.	266	76	100	500	143	149	3	95	189	12	5	25	1563
Ancient Murrelet	7	-	-	-	4	-	-	-	-	1	-	-	12
Crested Auklet	947	11	1201	545	7	12	-	-	-	283	2	-	3008
Least Auklet	-	-	-	-	-	-	-	-	-	-	-	-	0
Parakeet Auklet	-	-	-	-	-	-	-	-	-	-	-	-	0
Cassin's Auklet	-	-	-	-	-	-	-	-	-	-	-	-	0
Rhinocerous Auklet	-	-	-	-	-	1	-	-	-	-	-	-	0
Horned Puffin	-	-	-	-	-	-	-	-	-	-	-	-	0
Tufted Puffin	-	-	-	-	-	-	-	-	-	-	-	-	0
Unid. large Alcid	1	-	-	-	-	1	-	-	3	-	-	-	5
Unid. small Alcid	5	1	-	-	1	1	-	-	2	-	-	-	10
Belted Kingfisher	-	-	-	-	-	-	-	-	-	-	-	-	0
Black-billed Magpie	-	-	-	-	-	-	-	-	-	-	-	-	0
Common Raven	2	-	-	-	1	-	-	-	-	-	-	-	3
Northwestern Crow	-	-	-	-	-	-	-	-	-	-	-	-	0
Unid. Birds	-	-	-	-	2	-	-	-	-	-	-	-	2
Total Birds	6926	4924	3793	7177	2191	3075	769	20714	4891	1854	109	327	56750

[a] UY=Uyak Bay; UG=Uganik Bay; KV=Kurpreanof Strait-Viekoda Bay; WA=Whale Pass-Afognak Strait; MI=Marmot Bay -Izhut Bay; CH=Chiniak Bay; NA=Narrow Strait; ES=Eastern Sitkalidak Strait; WS=Western Sitkalidak Strait, IS=Inner Shelikof Strait Shelf; IP=Inner Pacific Shelf; OS=Outer Shelikof Strait Shelf

Table 17. Relative abundance[a] and relative density[b] indices for birds observed in shipboard surveys of Sitkalidak, Kodiak, and southeastern Afognak Islands, November 1979 and February 1980

Species	November 1979			February 1980		
	No. Birds In Transects	Relative Abundance	Relative Density	No. Birds In Transects	Relative Abundance	Relative Density
Loons	110	0.43	0.36	118	0.21	0.30
Grebes	133	0.52	0.43	248	0.44	0.63
Short-tailed Shearwater	1	+	+	0	-	-
Unid. Shearwater	1	+	+	0	-	-
Cormorants	1592	6.25	5.22	2047	3.61	5.20
Emperor Goose	2	0.01	0.01	0	-	-
Mallard	34	0.13	0.11	83	0.15	0.21
American Widgeon	0	-	-	5	0.01	0.01
Gadwall	0	-	-	9	0.02	0.02
Unid. Puddle Duck	2	0.01	0.01	31	0.05	0.07
Total Puddle Duck	36	0.14	0.12	128	0.23	0.33
Greater Scaup	98	0.38	0.32	258	0.46	0.66
Common Goldeneye	12	0.05	0.04	47	0.08	0.12
Barrow's Goldeneye	362	1.42	1.19	238	0.42	0.60
Unid. Goldeneye	3	0.01	0.01	307	0.54	0.78
Total Goldeneye	377	1.48	1.24	592	1.04	1.50
Bufflehead	82	0.32	0.27	107	0.19	0.27
Oldsquaw	3097	12.17	10.17	7563	13.33	19.20
Harlequin Duck	678	2.66	2.22	1051	1.85	2.67
Steller's Eider	17	0.07	0.06	114	0.20	0.29
Common Eider	0	-	-	4	0.01	0.01
King Eider	0	-	-	978	1.72	2.49
Unid. Eiders	13	0.05	0.04	507	0.89	1.29
Total Eiders	30	0.12	0.10	1603	2.93	4.07
White-winged Scoter	1721	6.76	5.65	2899	5.10	7.86
Surf Scoter	173	0.68	0.57	419	0.14	1.06
Black Scoter	1009	3.96	3.31	2711	4.78	6.88
Unid. Scoters	202	[illegible]	0.66	764	1.35	1.94
Common Merganser	2	0.01	0.01	35	0.06	0.09
Red-breasted Merganser	28	0.11	0.09	104	0.18	0.26
Unid. Merganser	23	0.09	0.08	39	0.07	0.10
Total Mergansers	53	0.21	0.17	178	0.31	0.45
Unid. Sea Duck	76	0.30	0.25	55	0.08	0.14
Total Sea Ducks	7596	29.84	24.93	18200	32.07	46.24
Rock Sandpiper	0	-	-	32	0.06	0.81
Black Oystercatcher	0	-	-	2	+	+
Unid. Shorebirds	35	0.14	0.12	30	0.05	0.08
Northern Phalarope	7	0.03	0.02	0	-	-
Glaucous Gull	2	0.01	0.01	0	-	-
Glaucous-winged Gull	434	1.70	1.42	732	1.29	1.86
Herring Gull	2	0.01	0.01	1	+	+
Mew Gull	468	1.84	1.53	832	1.47	2.11
Unid. *Larus* Gulls	20	0.08	0.07	60	0.11	0.16
Total *Larus* Gulls	926	3.64	3.04	1625	2.86	4.13
Black-legged Kittiwake	2040	8.01	6.69	248	0.44	0.63
Common Murre	1037	4.07	3.40	297	0.52	0.75
Thick-billed Murre	21	0.08	0.07	12	0.02	0.03
Unid. Murre	5635	22.14	18.49	27446	48.36	69.73
Total Murres	6693	26.29	21.96	27755	28.91	70.50
Pigeon Guillemot	507	1.99	1.66	823	1.45	2.09
Brachyramphus Murrelets	696	2.73	2.28	2437	4.29	6.19
Ancient Murrelet	12	0.05	0.04	12	0.02	0.03
Cassin's Auklet	1	+	+	0	-	-
Crested Auklet	4861	19.10	15.95	3008	5.30	7.64
Least Auklet	1	+	+	0	-	-
Rhinoceros Auklet	1	+	+	1	+	+
Horned Puffin	59	0.23	0.19	0	-	-
Tufted Puffin	37	0.15	0.12	0	-	-
Unid. Small Alcid	64	0.25	0.21	10	0.02	0.03
Unid. Large Alcid	27	0.11	0.09	5	0.01	0.01
Total Alcids	12959	50.91	42.53	34051	60.00	86.46
Common Raven	0	-	-	3	0.01	0.01
Northwestern Crow	8	0.03	0.03	0	-	-
Bald Eagle	9	0.04	0.03	16	0.03	0.04
Peregrine Falcon	1	+	+	0	-	-
Belted Kingfisher	1	+	+	0	-	-
Unid. Bird	4	+	+	2	0.01	0.01
Total Birds	25462	100.00	83.53	56750	100.00	144.18

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[a] Relative abundance: Number of birds of each species divided by the number of birds of all species or the percent of total bird

[b] Relative density: Relative abundance times total birds per square kilometer

Table 18. Whale observations in Kodiak Island waters November 1979 - March 1980

Species	Number	Location		
		Da-Mo-Yr	Lat.	Long.
Gray	1	15-11-79	57°16'N	152°45'W
Beaked (*Mesoplodon*)	1	30-11-79	57°05'N	153°34'W
Gray	1	03-12-79	57°15'N	152°43'W
Gray	1	04-12-79	57°19'N	152°34'W
Gray	1	13-11-79	57°51'N	153°33'W
Gray	6+	26-11-79	57°37'N	152°08'W
Gray	6	26-11-79	57°13'N	152°55'W
Fin	1	24-01-80	57°49'N	153°28'W
Humpback (?)	1	27-02-80	57°45'N	153°55'W
Killer	10	28-02-80	57°59'N	153°50'W
Killer	10	15-02-80	57°40'N	152°10'W
Killer	20	19-02-80	57°21'N	152°26'W
Gray	2	03-03-80	57°59'N	152°27'W
Gray	2	09-03-80	57°48'N	152°17'W

Table 19. Preferred habitats and estimated populations of seabirds wintering in the Kodiak study area

Species-Species Group	Estimated Populations		Preferred Habitat
	Bay & Coast[a]	Offshore	
Loons	1,100		Protected coast
Grebes	2,250		Nearshore in bays
Northern Fulmar		73,000	Shelfbreak
Shearwaters		2,700	Oceanic
Fork-tailed Storm-petrel		3,200	Oceanic
Leach's Storm-petrel		500	Oceanic
Cormorants	18,500	+	Rocky coast
Geese	1,650		Rocky intertidal
Puddle Ducks	11,500		Estuaries and lagoons
Scaup	3,750		Nearshore in bays
Goldeneyes	8,700		Nearshore in bays
Oldsquaw	65,000	+	Rocky headlands & bays
Harlequin Duck	9,600		Rocky coast
Steller's Eider	1,100	+	Nearshore in bays
Common Eider	450	+	Bays and shallow shelf
King Eider	13,000	+	Bays and shallow shelf
White-winged Scoter	35,000	+	Bays out from shore
Surf Scoter	5,000	+	Bays out from shore
Black Scoter	30,000	+	Nearshore and shallow shelf
Common Merganser	500		Nearshore
Red-breasted Merganser	1,000		Nearshore
Glaucous-winged Gull	6,250	45,000	Bay and inner shelf
Mew Gull	10,000	3,500	Bay and estuary
Black-legged Kittiwake		65,000	Shelfbreak
Common Murre	200,000	800,000	Outer bay and shelf
Pigeon Guillemot	7,000		Rocky coast
Murrelets	17,800		Inner bays
Crested Auklet	50,000		Nearshore in bays
Horned Puffin		2,000	Continental shelf
Tufted Puffin		2,750	Oceanic
Total birds[b]	500,000	1,000,000	Shallow nearshore areas

[a] Bay and coast estimates include only Kodiak, Sitkalidak, and southern Afognak Island's waters.

[b] Includes species not listed above.

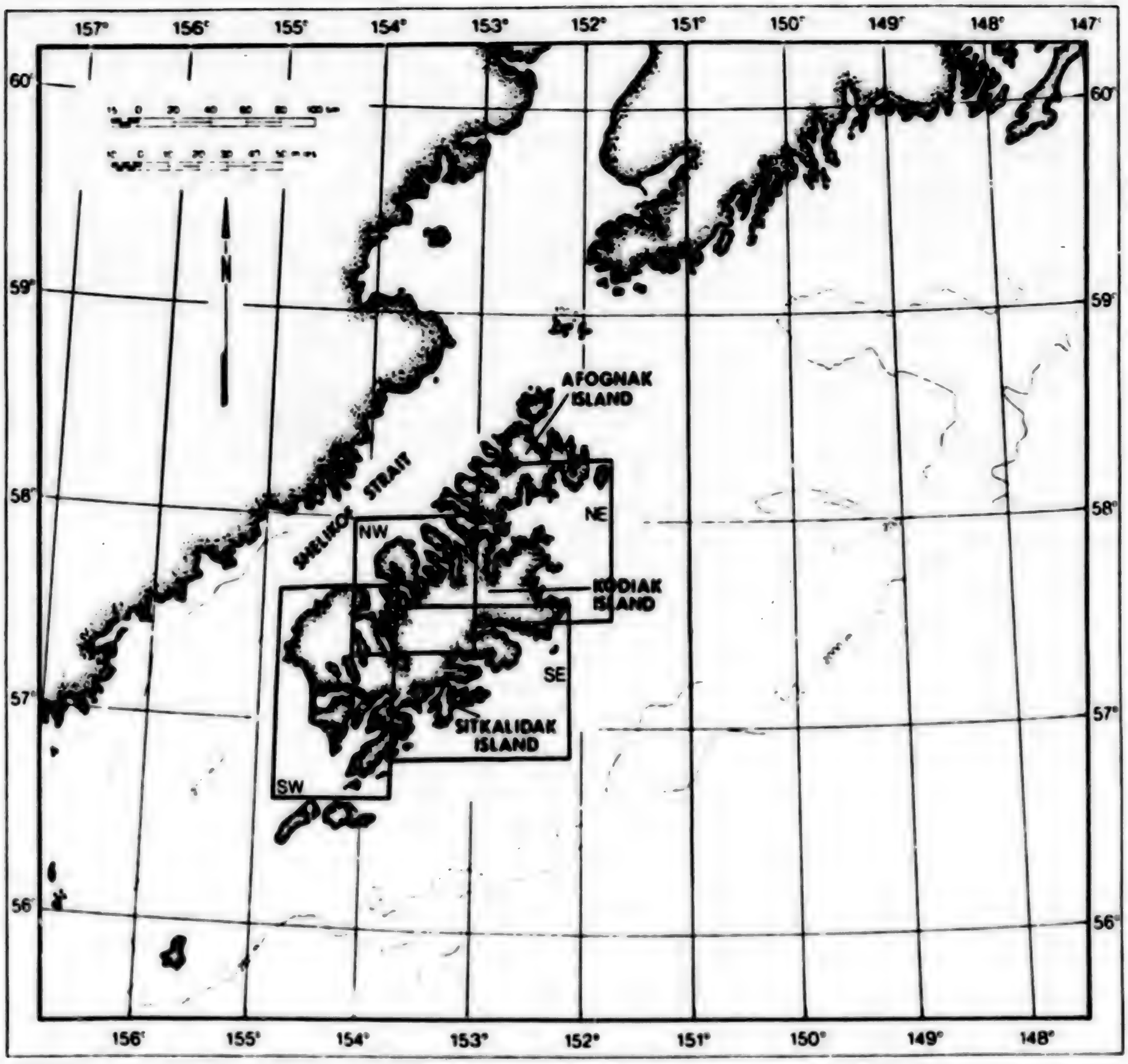

Figure 1. Major islands surveyed in the Kodiak Archipelago.

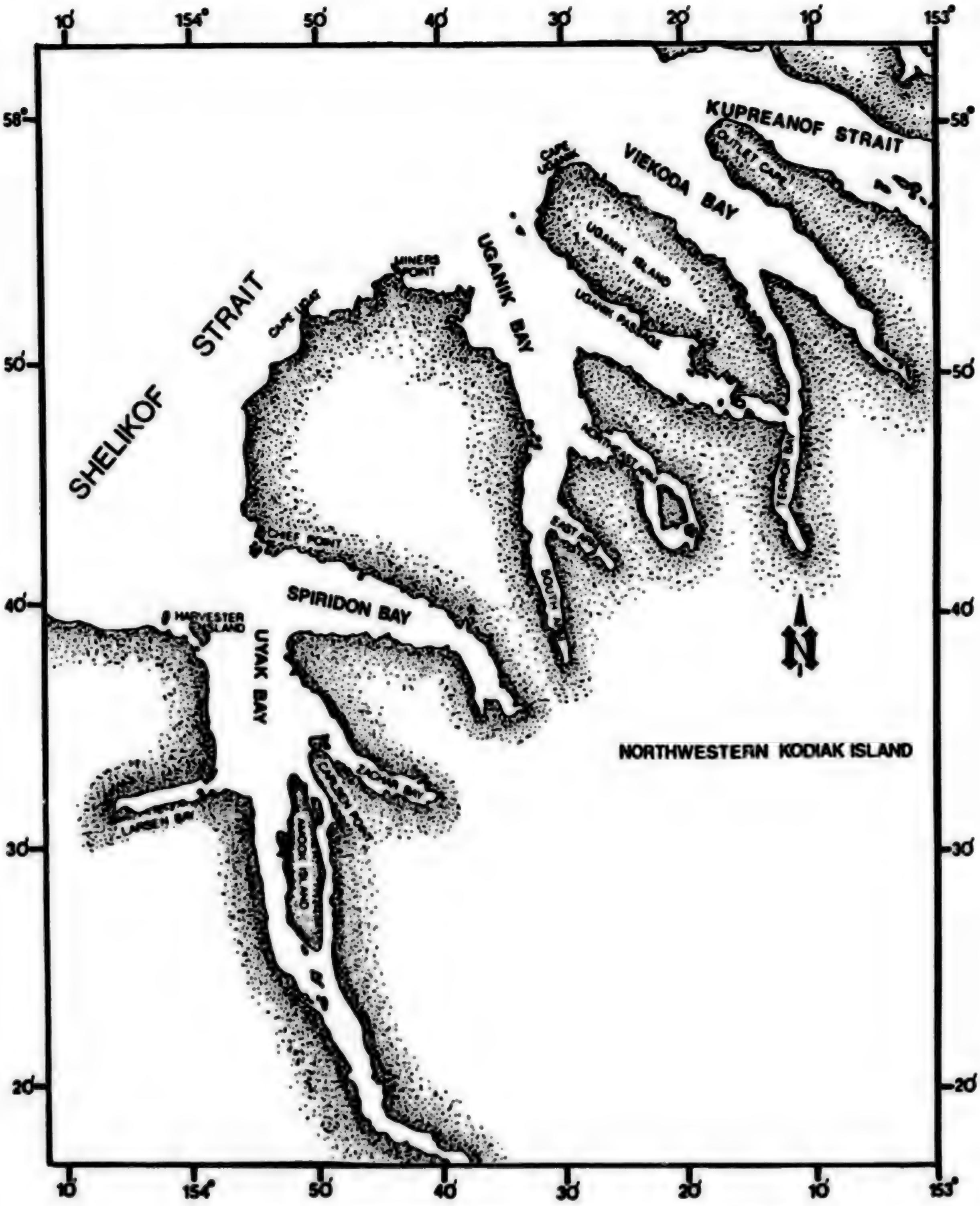

Figure 2. Northwestern section of the study area.

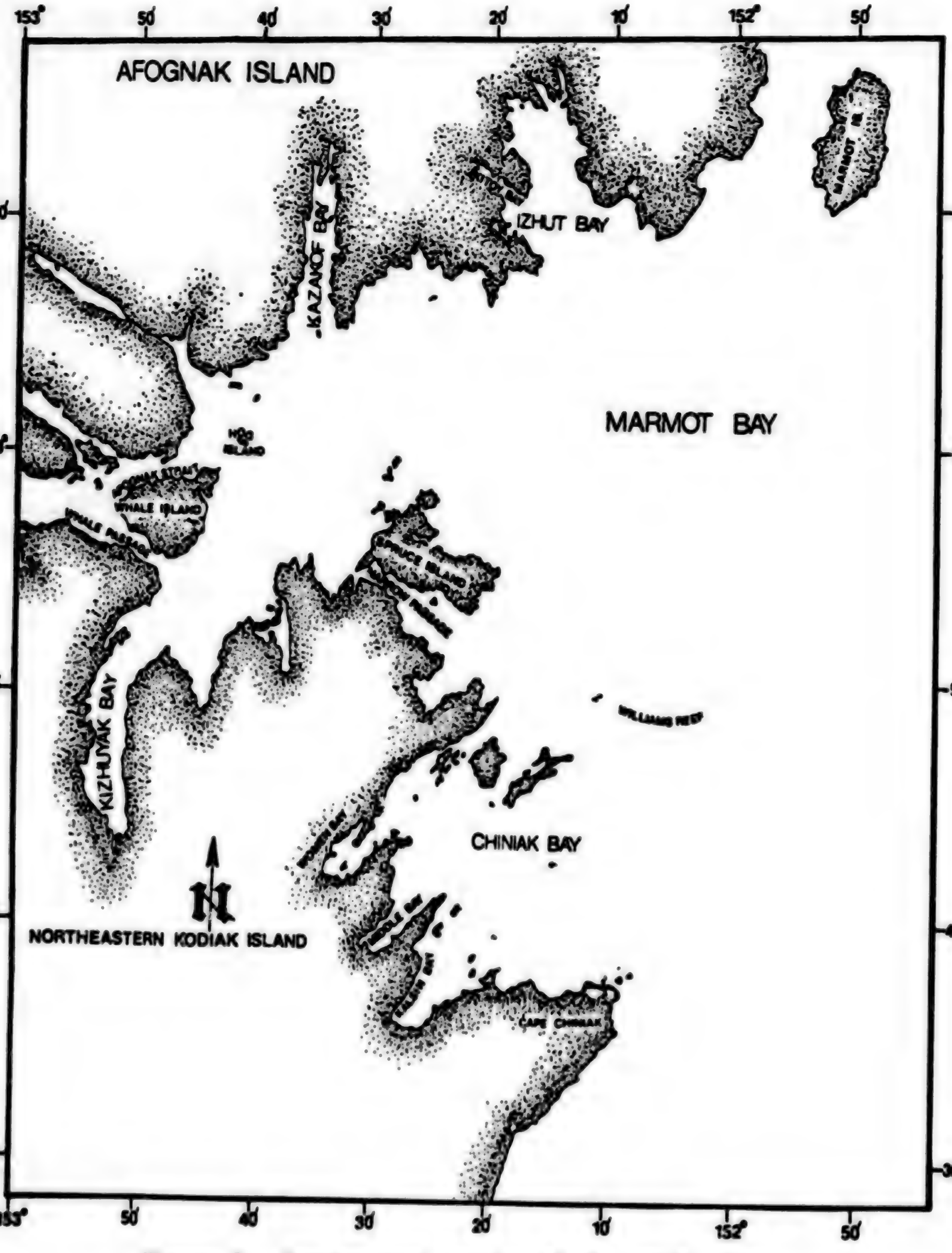

Figure 3. Northeastern section of the study area.

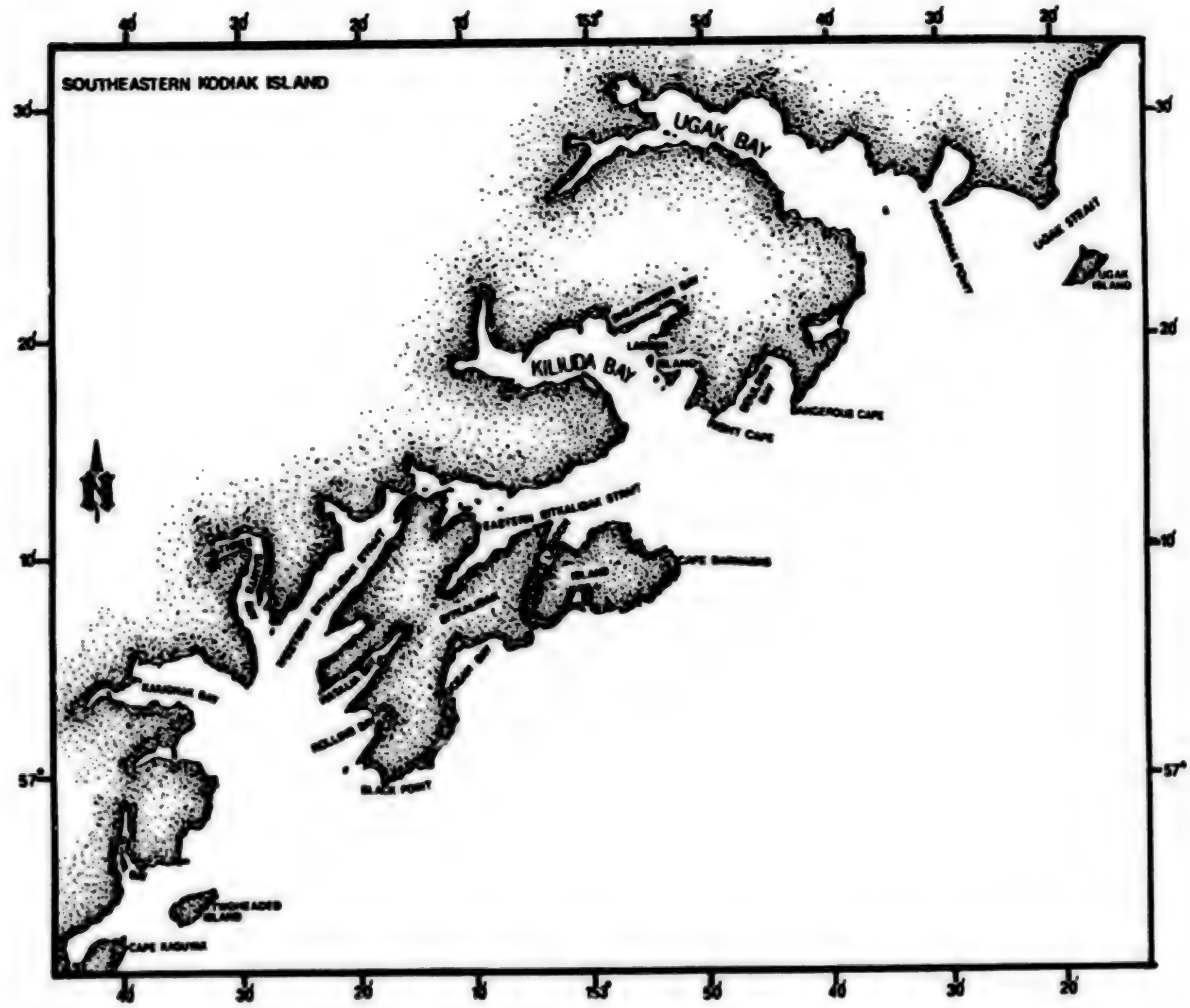

Figure 4. Southeastern section of the study area.

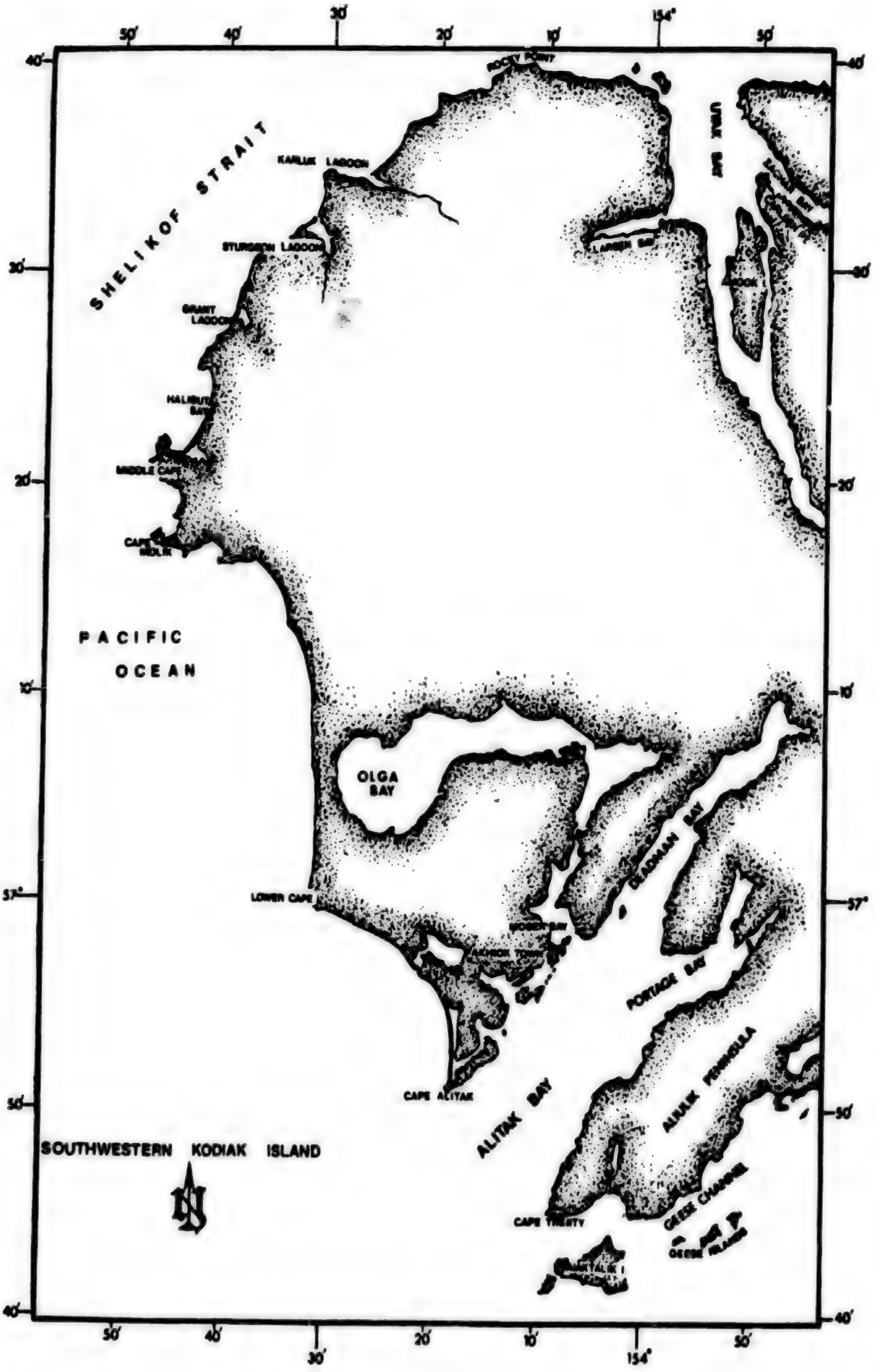

Figure 5. Southwestern section of the study area.

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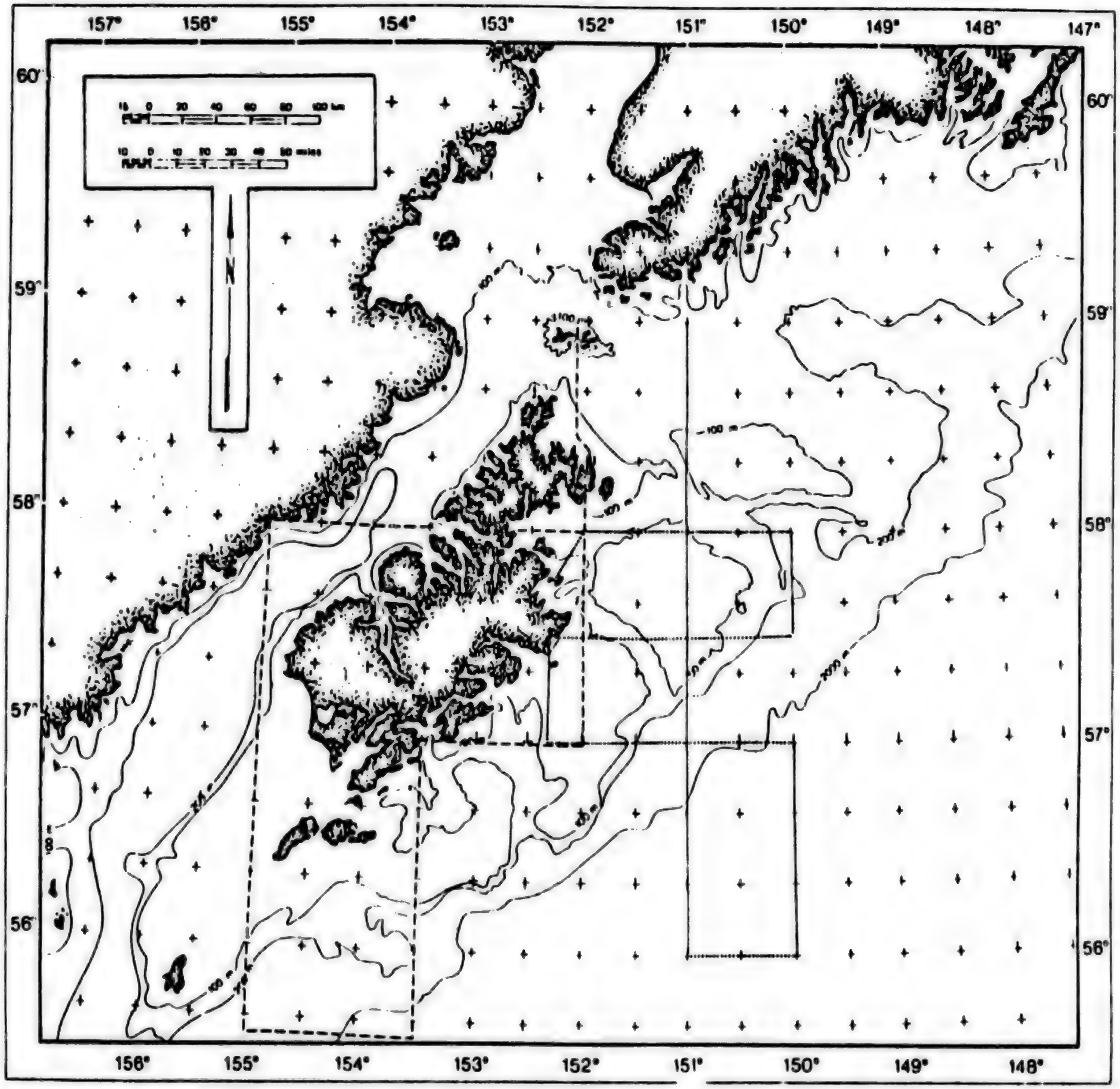


Figure 6. Trackline of the large plane survey over the Kodiak Archipelago. Dotted line completed on 16 February; dashed line completed on 17 Febraury 1980.

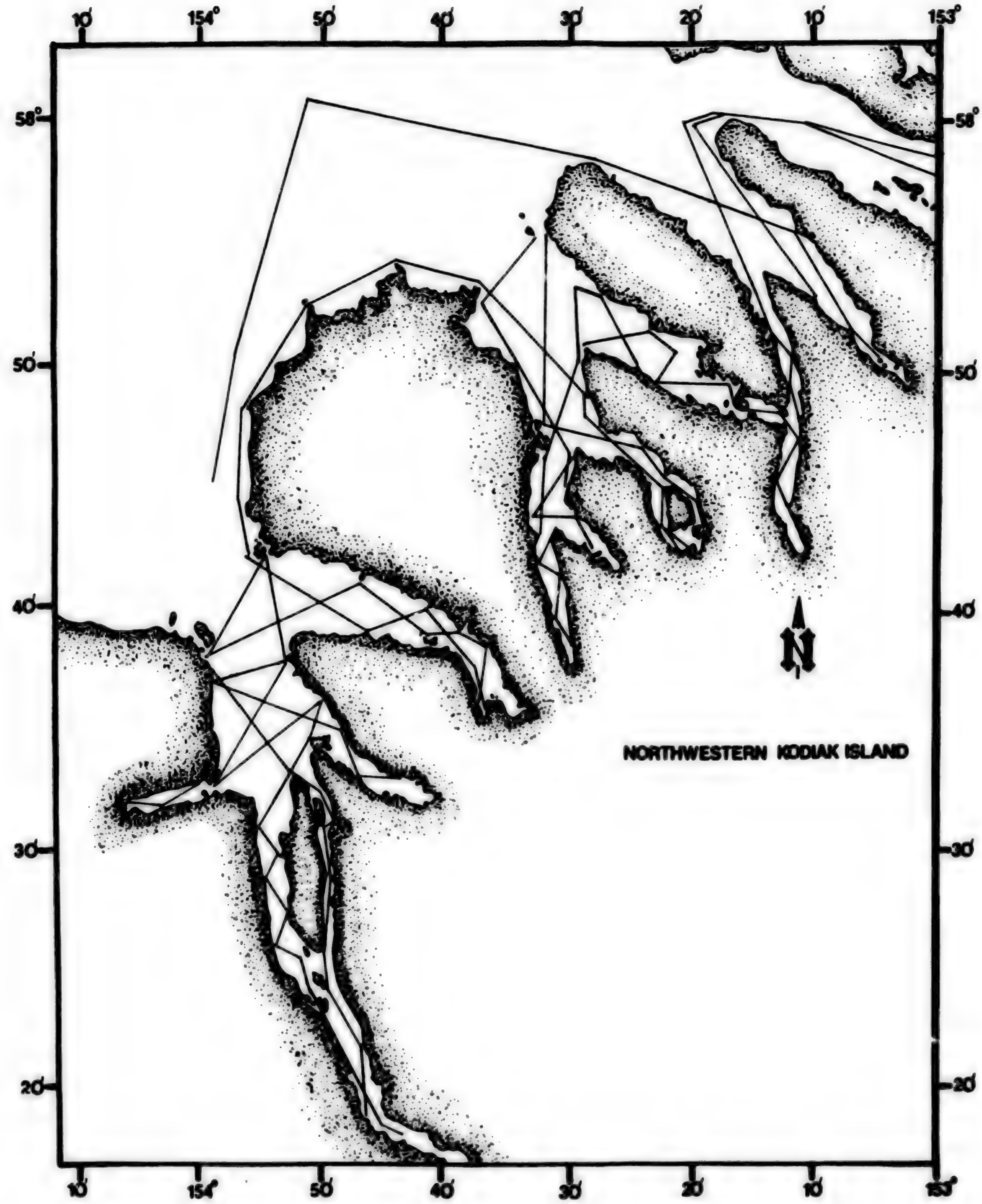


Figure 7. Survey tracks from the cruise of the R-V Ursa Major, Northwest Kodiak, February-March 1980.

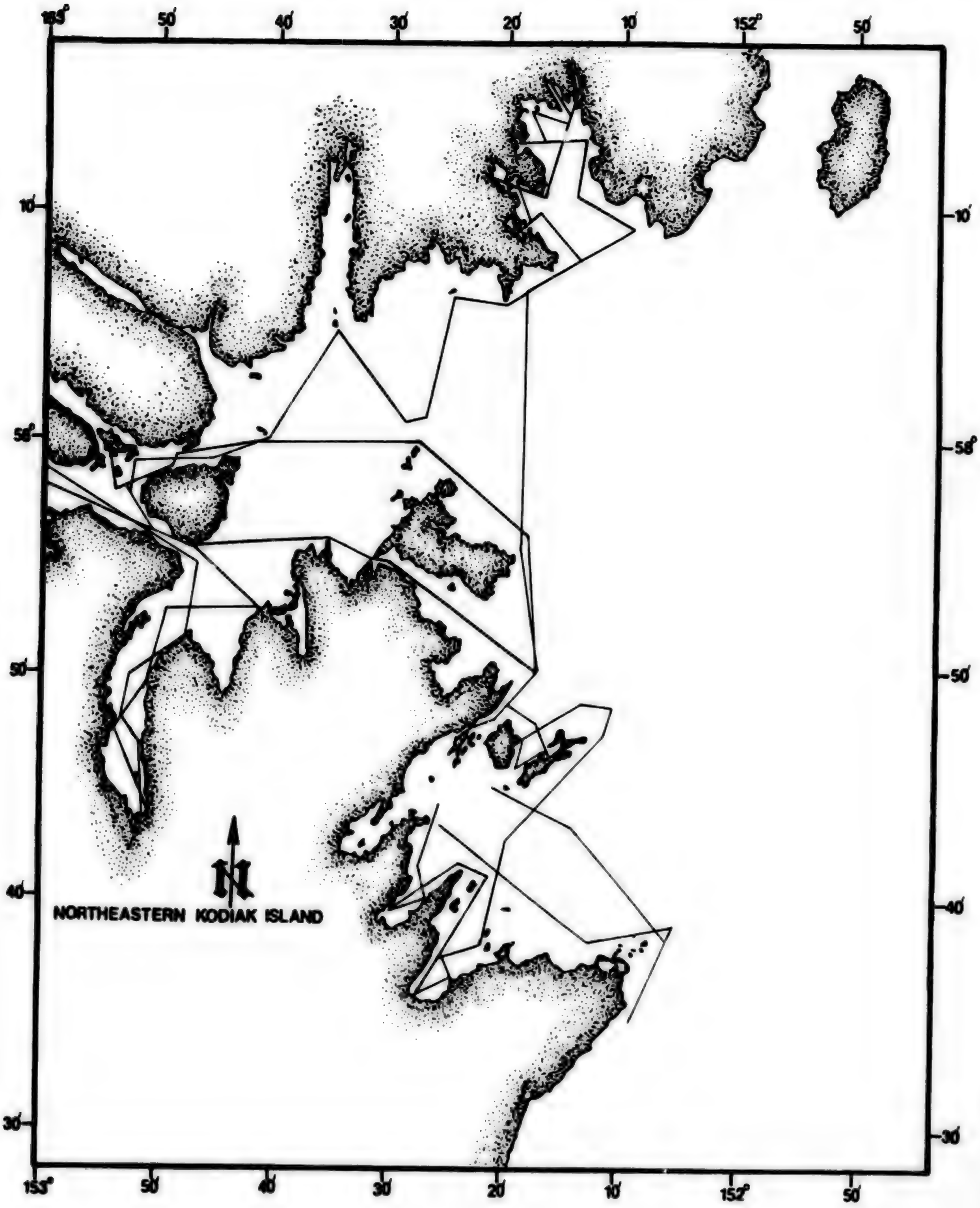


Figure 8. Survey tracks from the cruise of the R-V Ursa Major, Northeast Kodiak, February-March 1980.

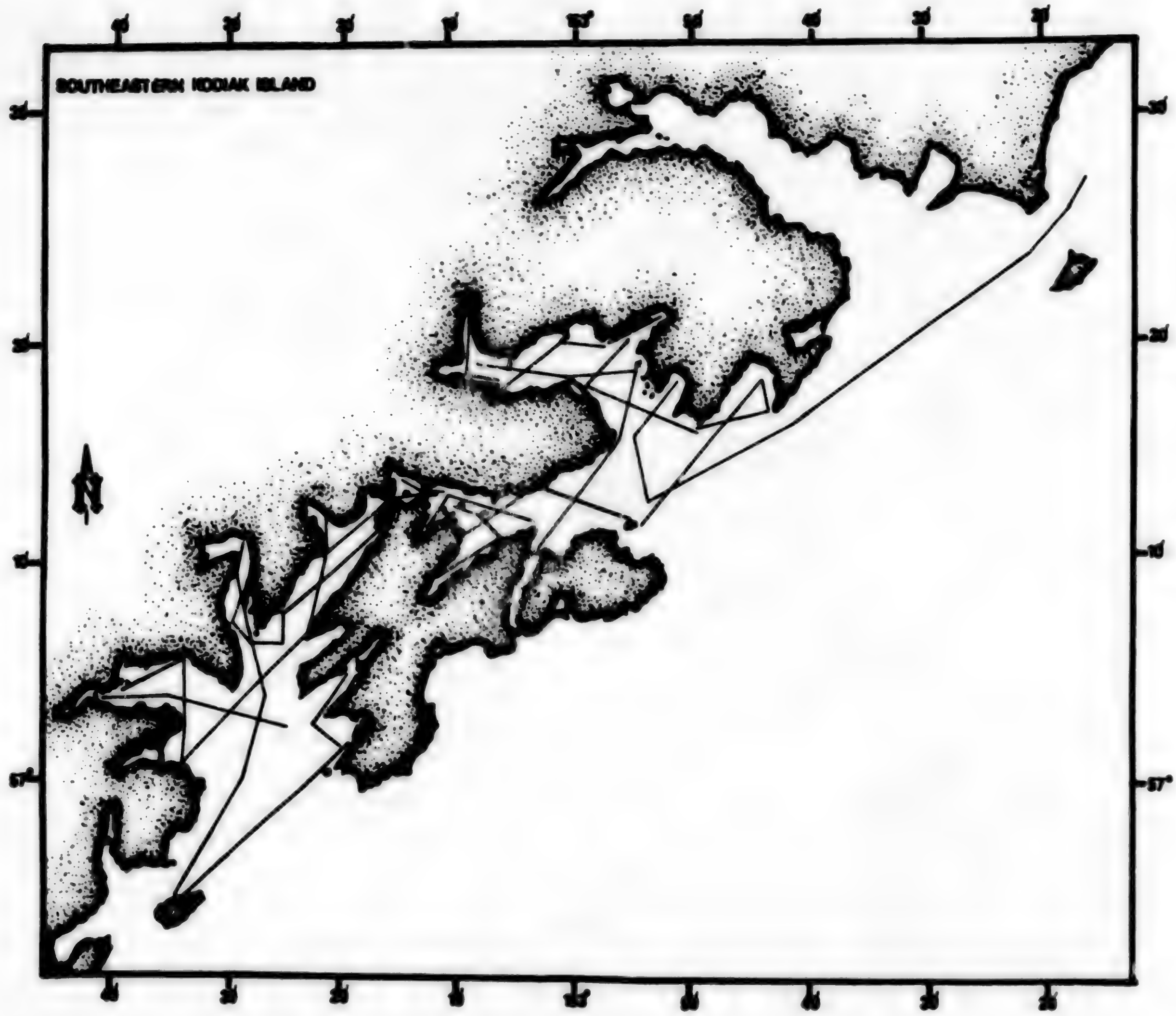
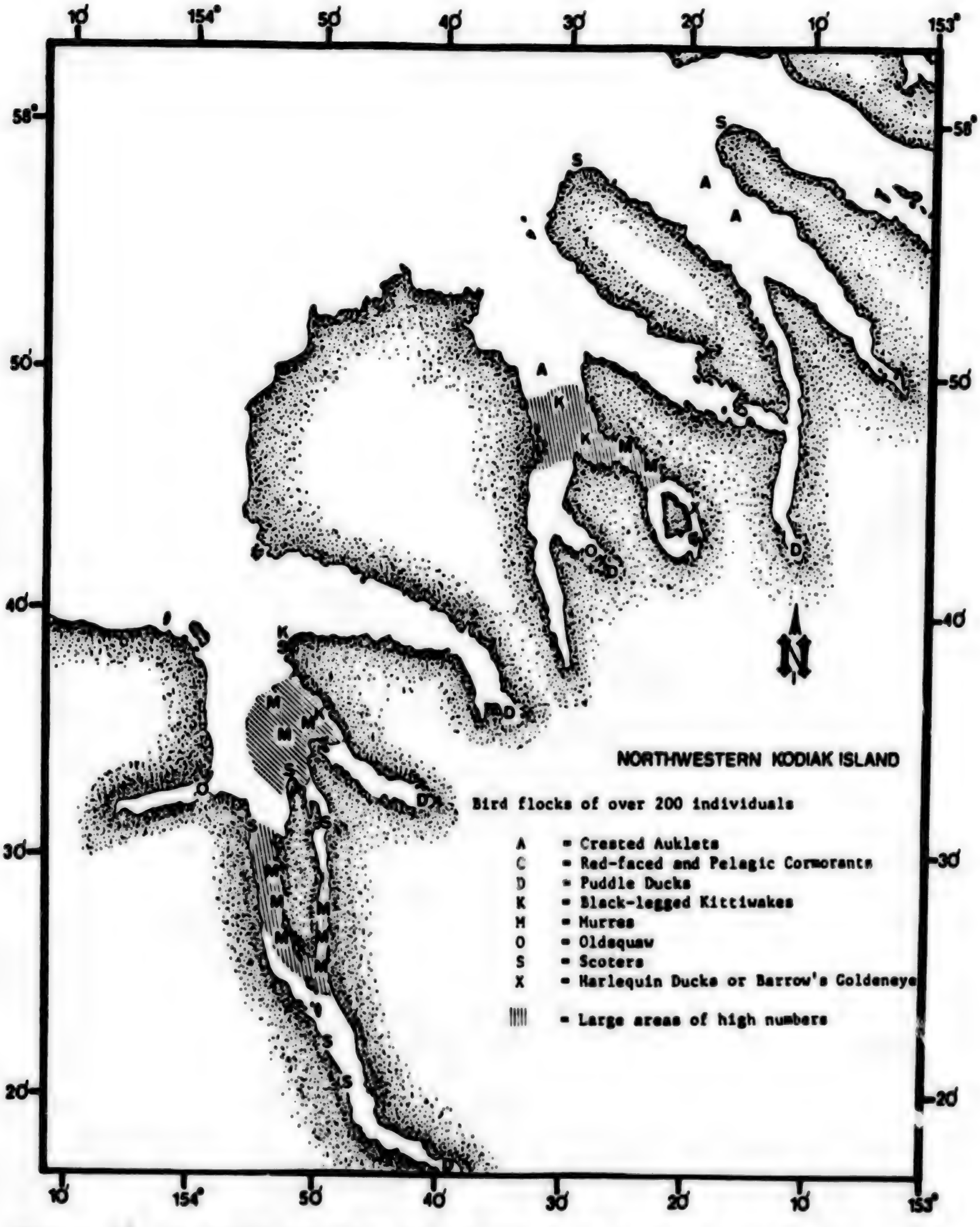


Figure 9. Survey tracks from the cruise of the R-V Ursa Major, Southeast Kodiak, February-March 1980.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N
NORTHWESTERN KODIAK ISLAND
Bird flocks of over 200 individuals
A = Crested Auklets
C = Red-faced and Pelagic Cormorants
D = Puddle Ducks
K = Black-legged Kittiwakes
M = Murres
O = Oldsquaw
S = Scoters
X = Harlequin Ducks or Barrow's Goldeneye
||||| = Large areas of high numbers

Figure 10. Location of major flocks and areas of high density of seabirds, Northwest Kodiak, November-December 1979.

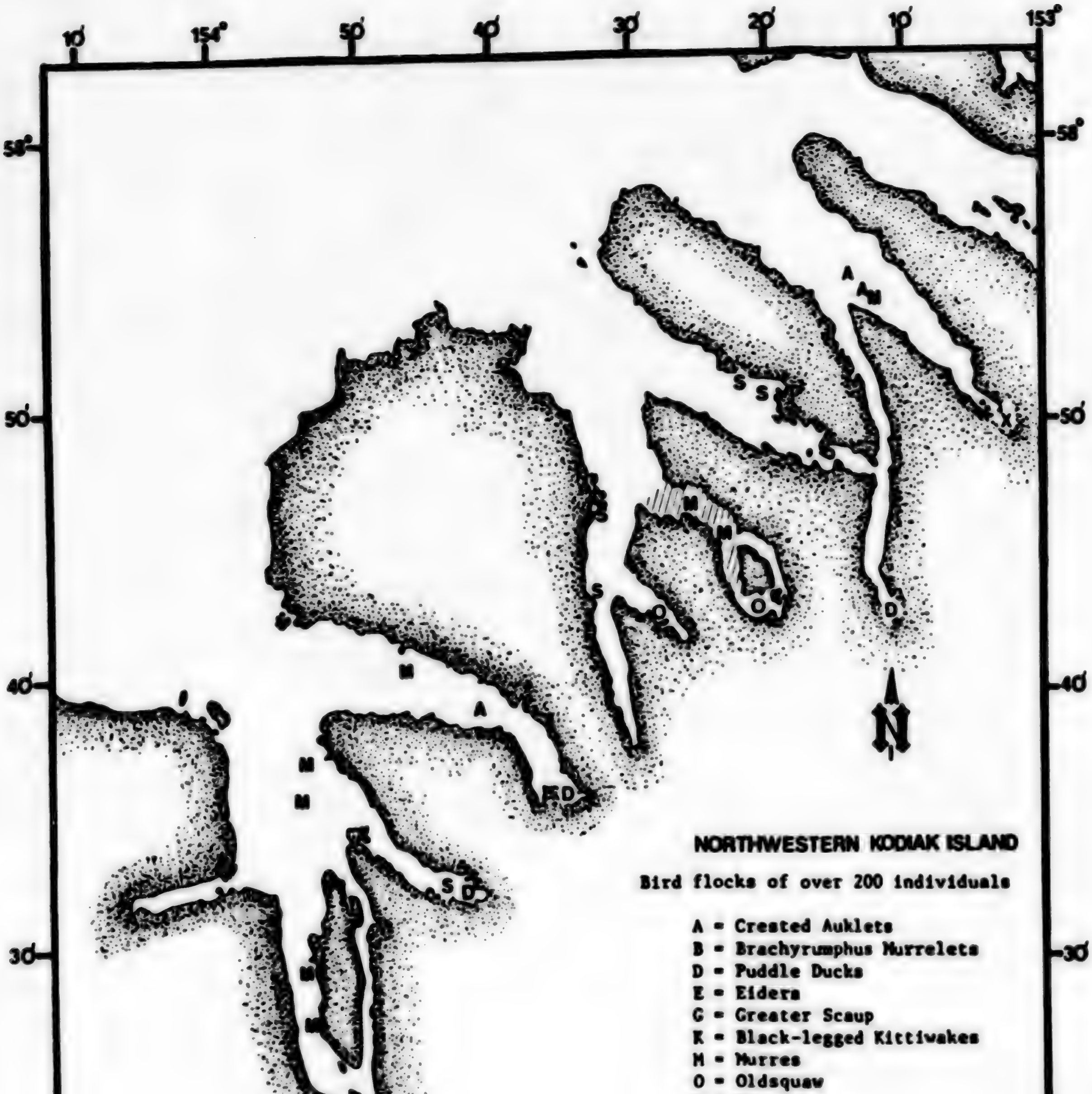
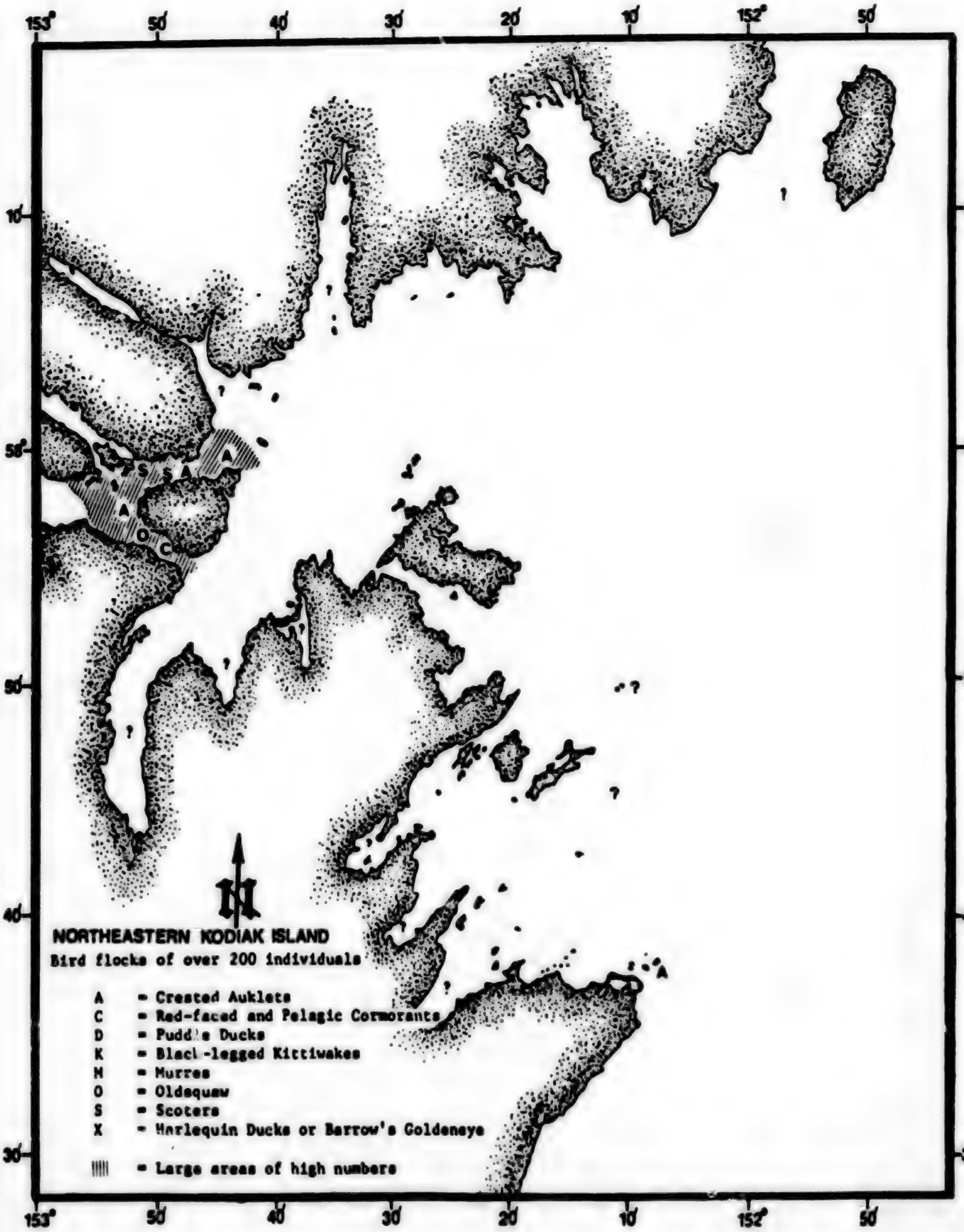


Figure 11. Location of major flocks and areas of high density of seabirds, Northwest Kodiak, February-March 1980.


153°
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30'
S
S
A
A
A
O
C
A
NORTHEASTERN KODIAK ISLAND
Bird flocks of over 200 individuals
A = Crested Auklets
C = Red-faced and Pelagic Cormorants
D = Puddle Ducks
K = Black-legged Kittiwakes
M = Murres
O = Oldsquaw
S = Scoters
X = Harlequin Ducks or Barrow's Goldeneye
||||| = Large areas of high numbers

Figure 12. Location of major flocks and areas of high density of seabirds, Northeast Kodiak, November-December 1979.

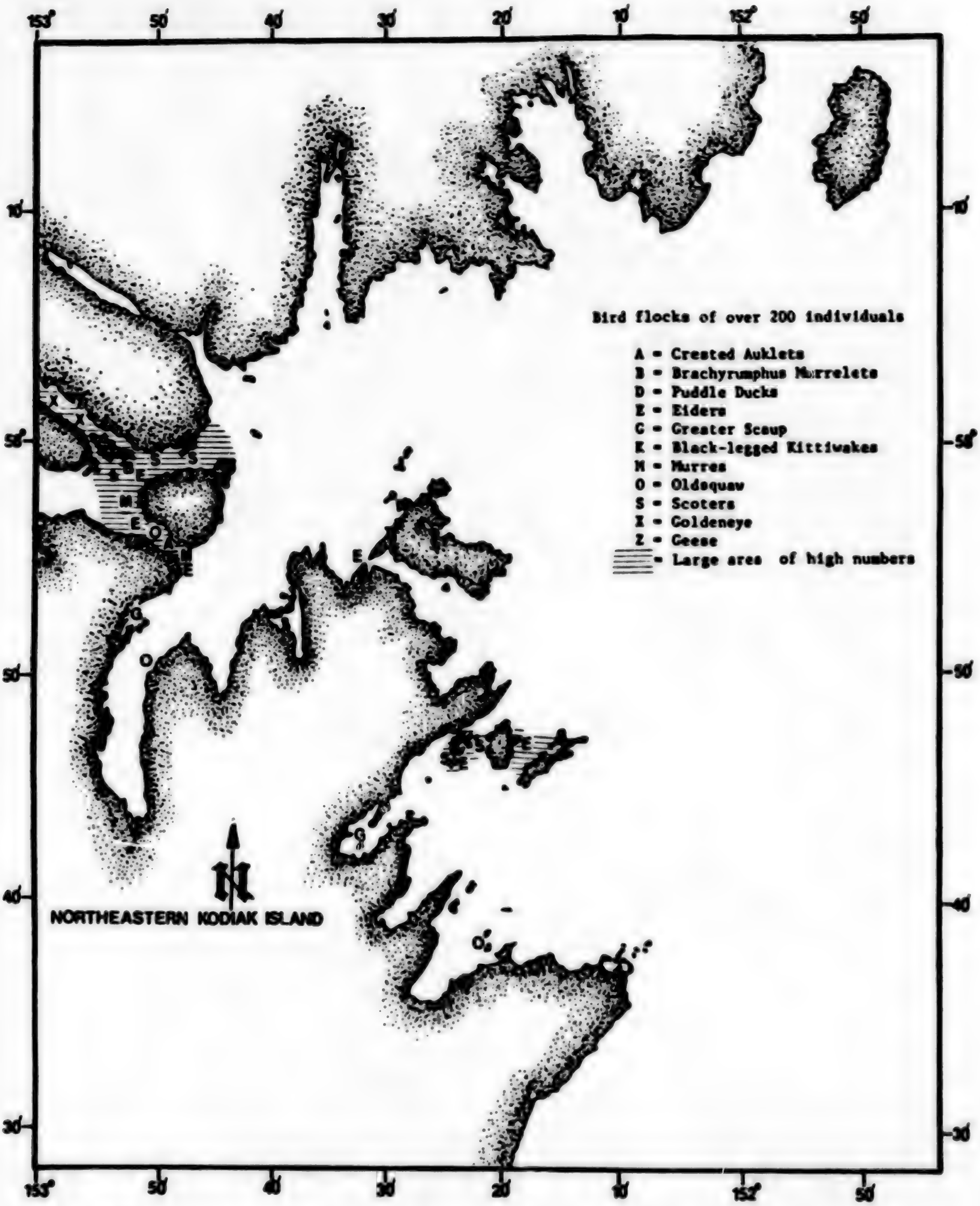

Figure 13. Location of major flocks and areas of high density of seabirds, Northeast Kodiak, February-March, 1980.

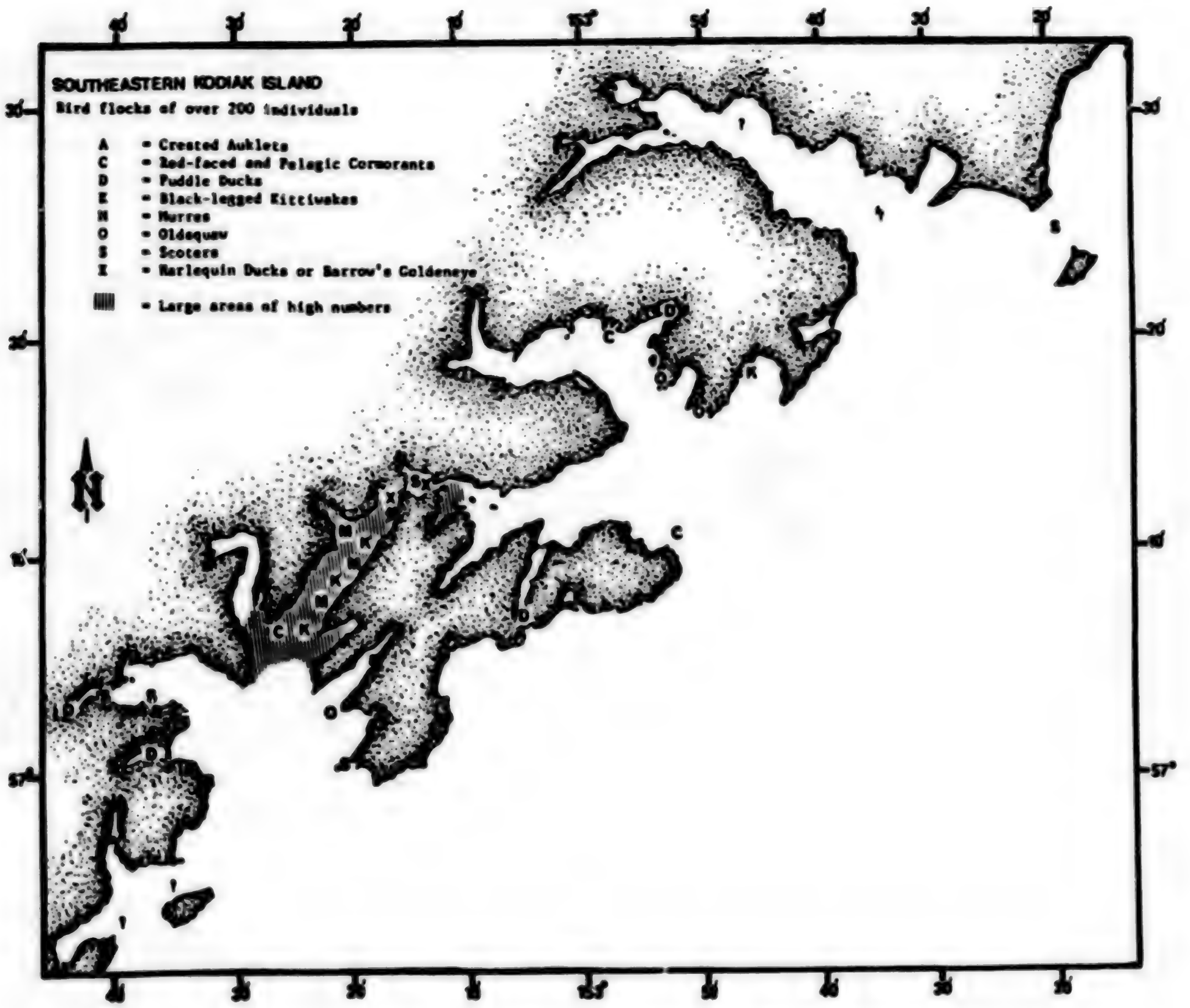
SOUTHEASTERN KODIAK ISLAND
Bird flocks of over 200 individuals
A = Crested Auklets
C = Red-faced and Pelagic Cormorants
D = Puddle Ducks
K = Black-legged Kittiwakes
M = Murres
O = Oldsquaw
S = Scoters
X = Harlequin Ducks or Barrow's Goldeneye
▥ = Large areas of high numbers
N
40'
30'
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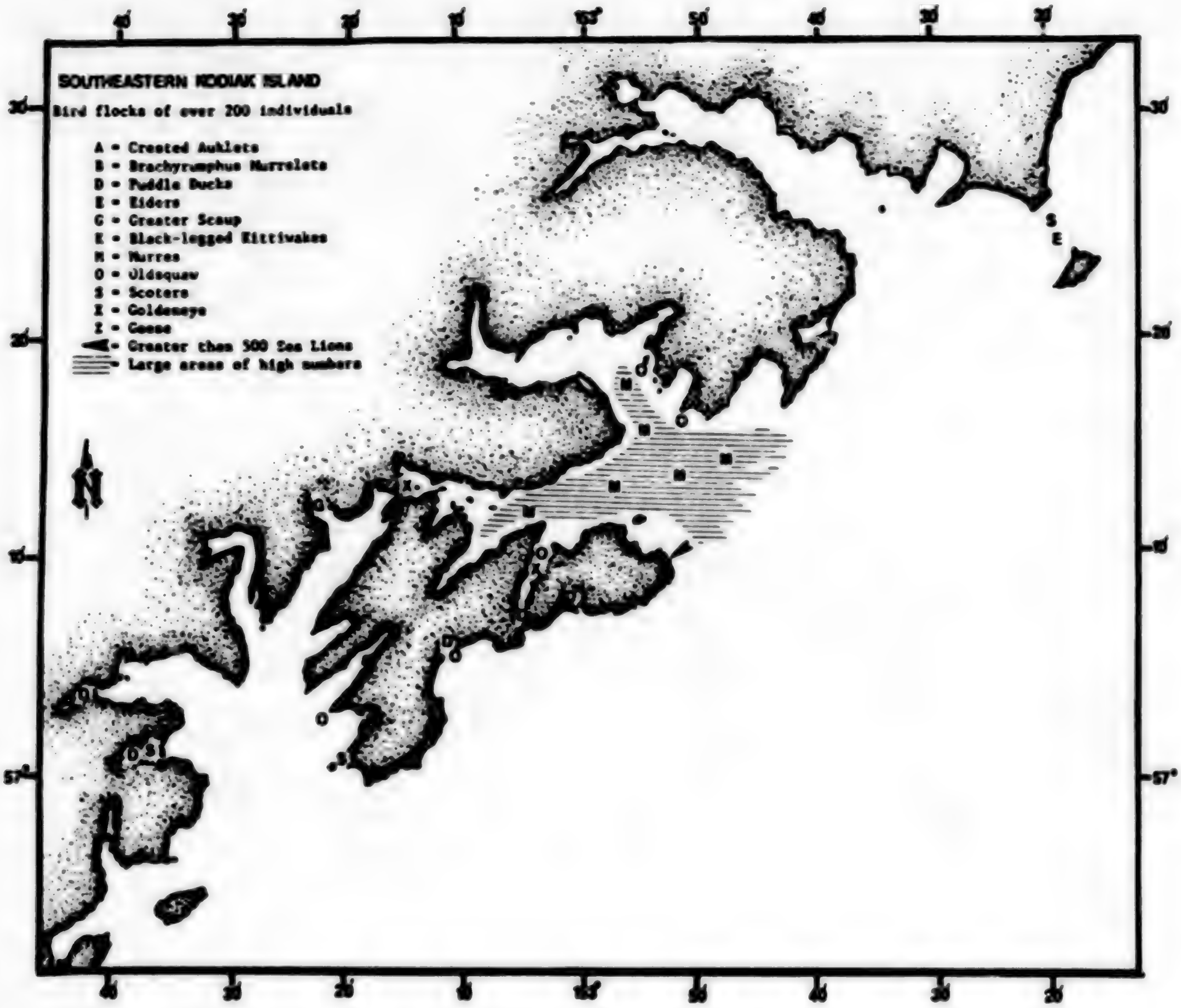
Figure 14. Location of major flocks and areas of high density of seabirds, Southeast Kodiak, November-December, 1979.



SOUTHEASTERN KODIAK ISLAND
Bird flocks of over 200 individuals
A = Crested Auklets
B = Brachyramphus Murrelets
D = Puddle Ducks
E = Eiders
G = Greater Scaup
K = Black-legged Kittiwakes
M = Murres
O = Oldsquaw
S = Scoters
X = Goldeneye
Z = Geese
Greater than 500 Sea Lions
Large areas of high numbers
N
40
30
20
10
153°
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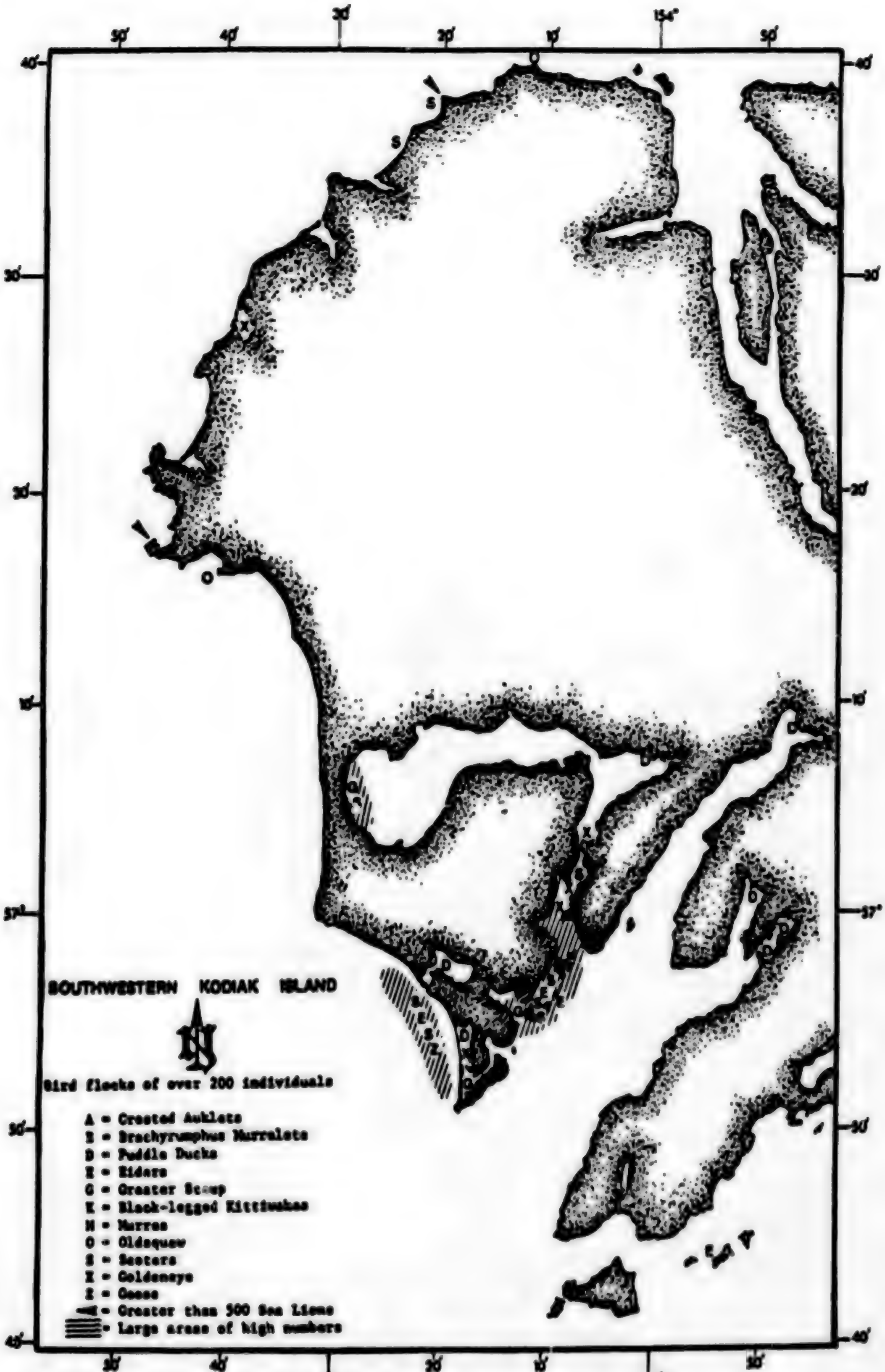
57°

Figure 15. Location of major flocks and areas of high density of seabirds, Southeast Kodiak, February-March, 1980.



50'
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154°
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20'
10'
57°
SOUTHWESTERN KODIAK ISLAND
N
Bird flocks of over 200 individuals
A = Crested Auklets
B = Brachyrumphus Murrelets
D = Puddle Ducks
E = Eiders
G = Greater Scaup
K = Black-legged Kittiwakes
M = Murres
O = Oldsquaw
S = Scoters
X = Goldeneye
Z = Geese
= Greater than 500 Sea Lions
= Large areas of high numbers
S
O
D
G
K
X

Figure 16. Location of major flocks and areas of high density of seabirds, Southwest Kodiak, February-March, 1980.

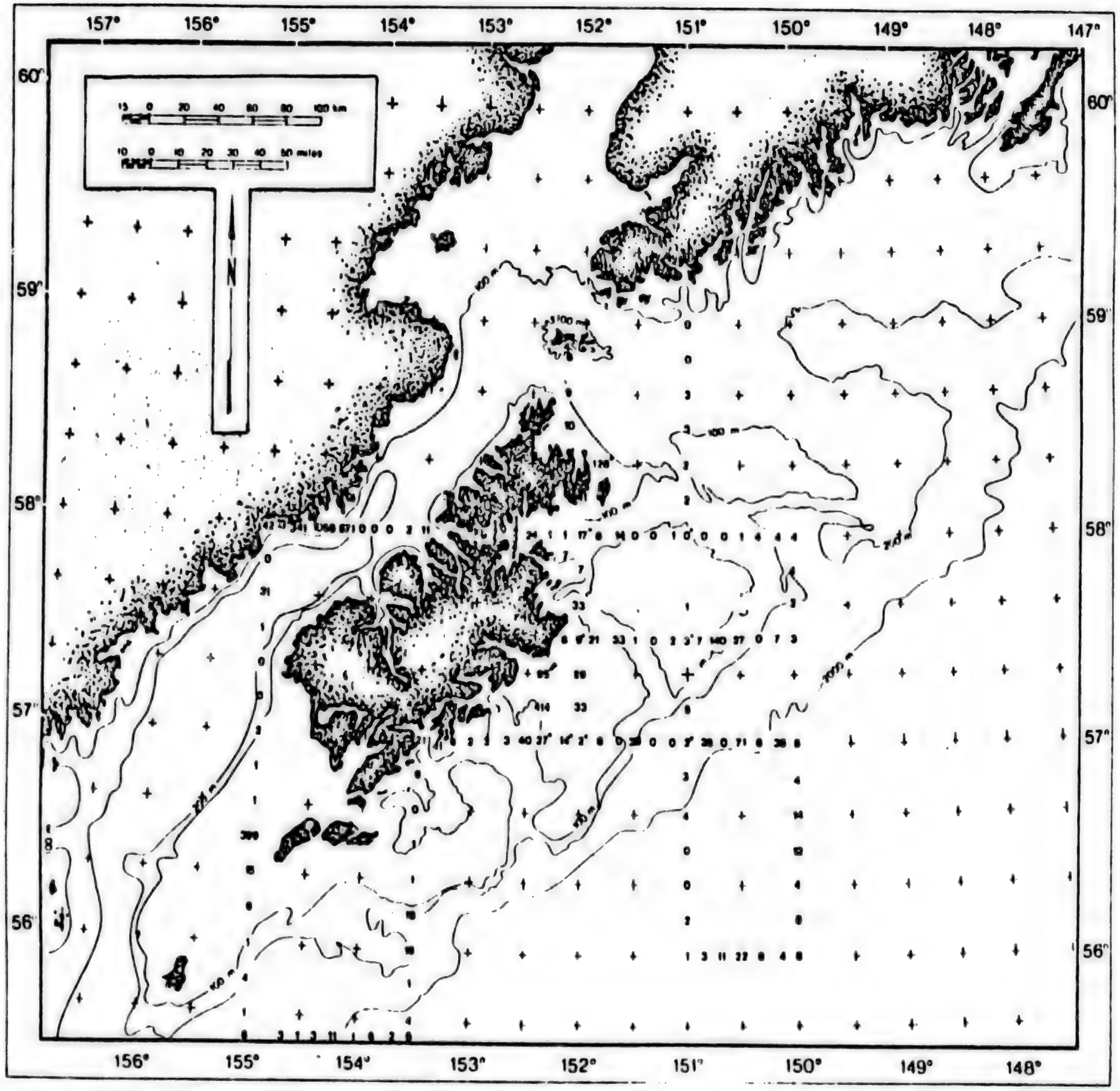

Figure 17. Density (Birds/km^2) for total seabirds found in large plane surveys of the Kodiak Archipelago, February 1980.

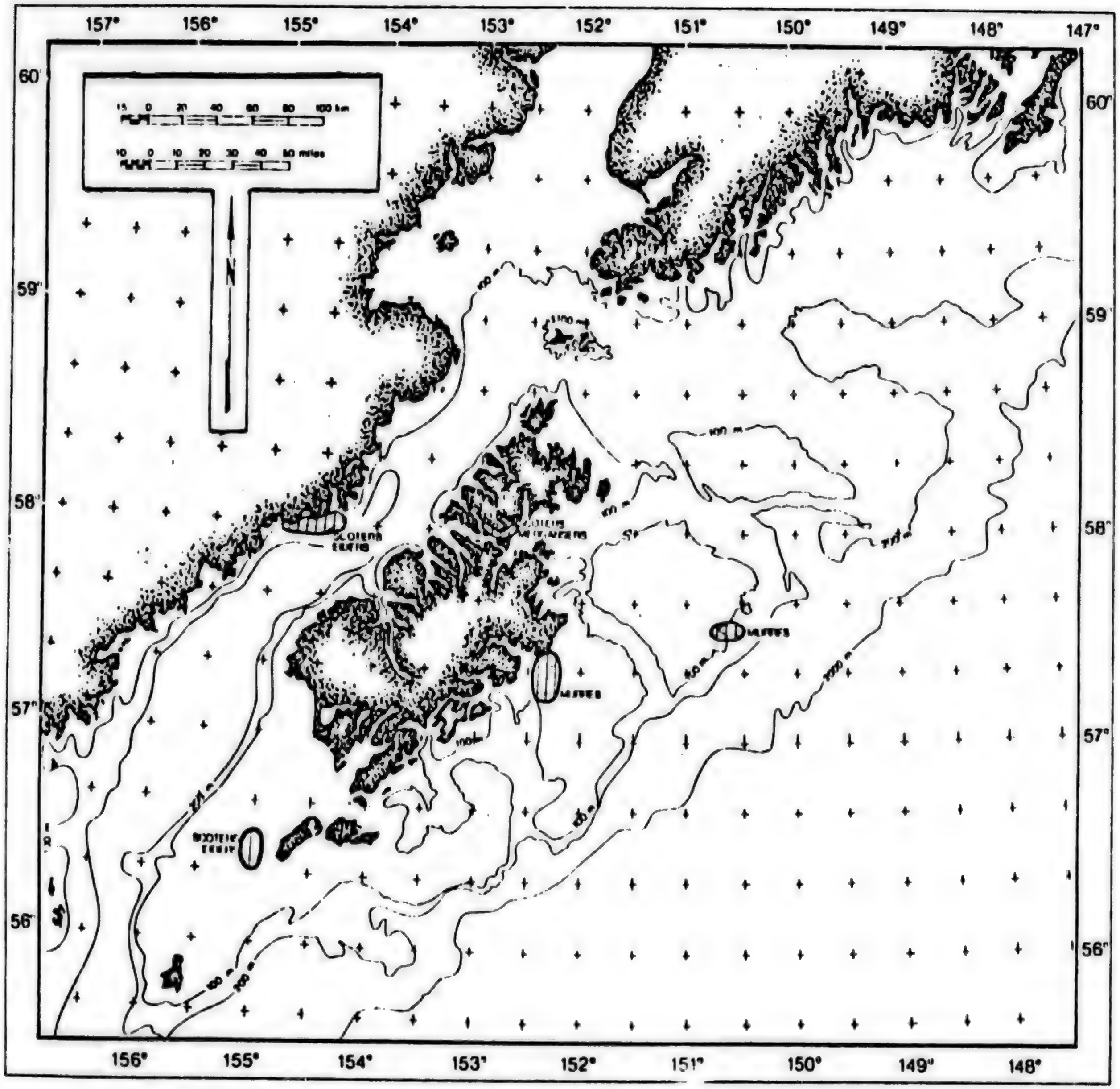

Figure 18. Location of high seabird densities over the Kodiak Archipelago as determined from large plane surveys, February 1980.

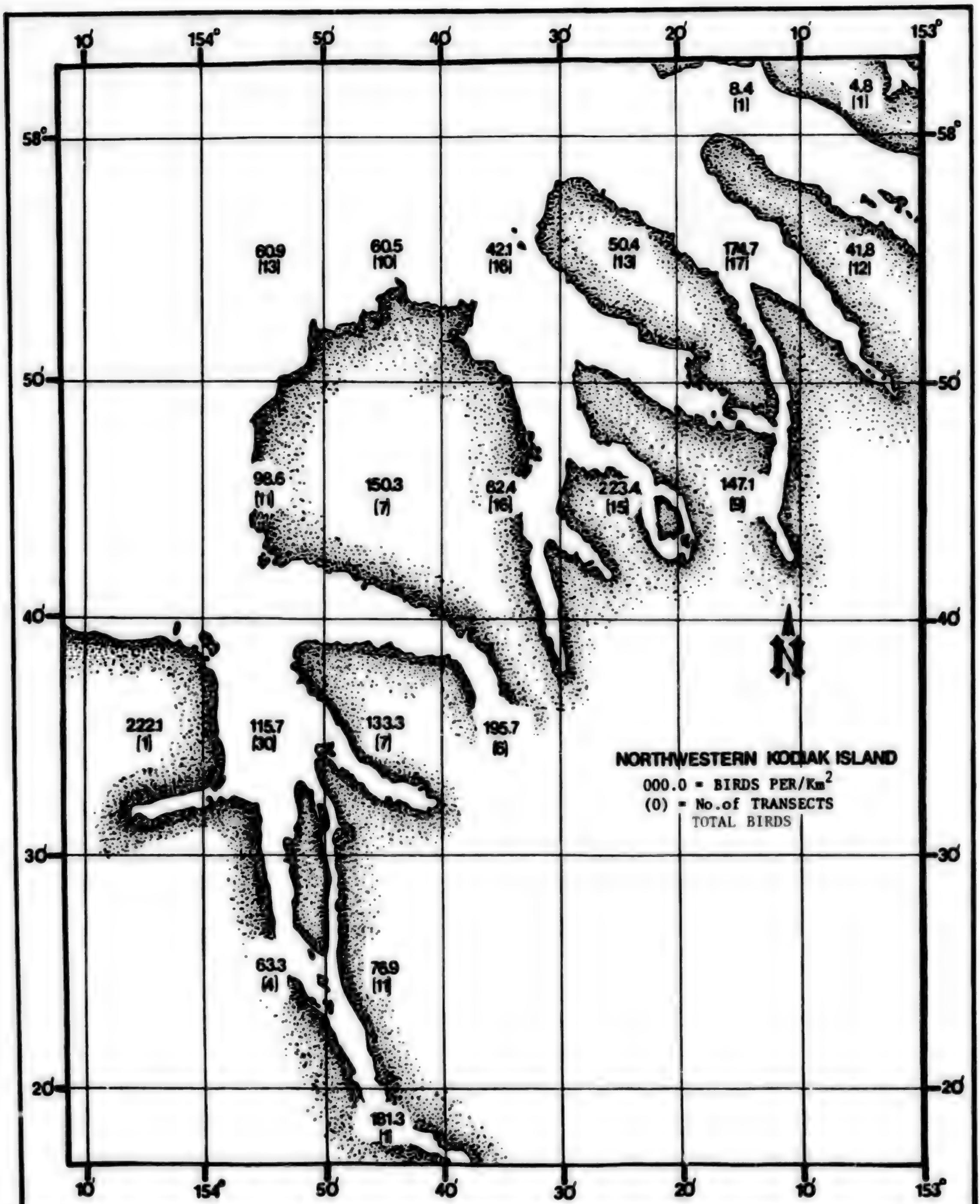

Figure 19. Density indices by 10-minute latitude and longitude blocks for Total Birds, Northwest Kodiak, February-March 1980.

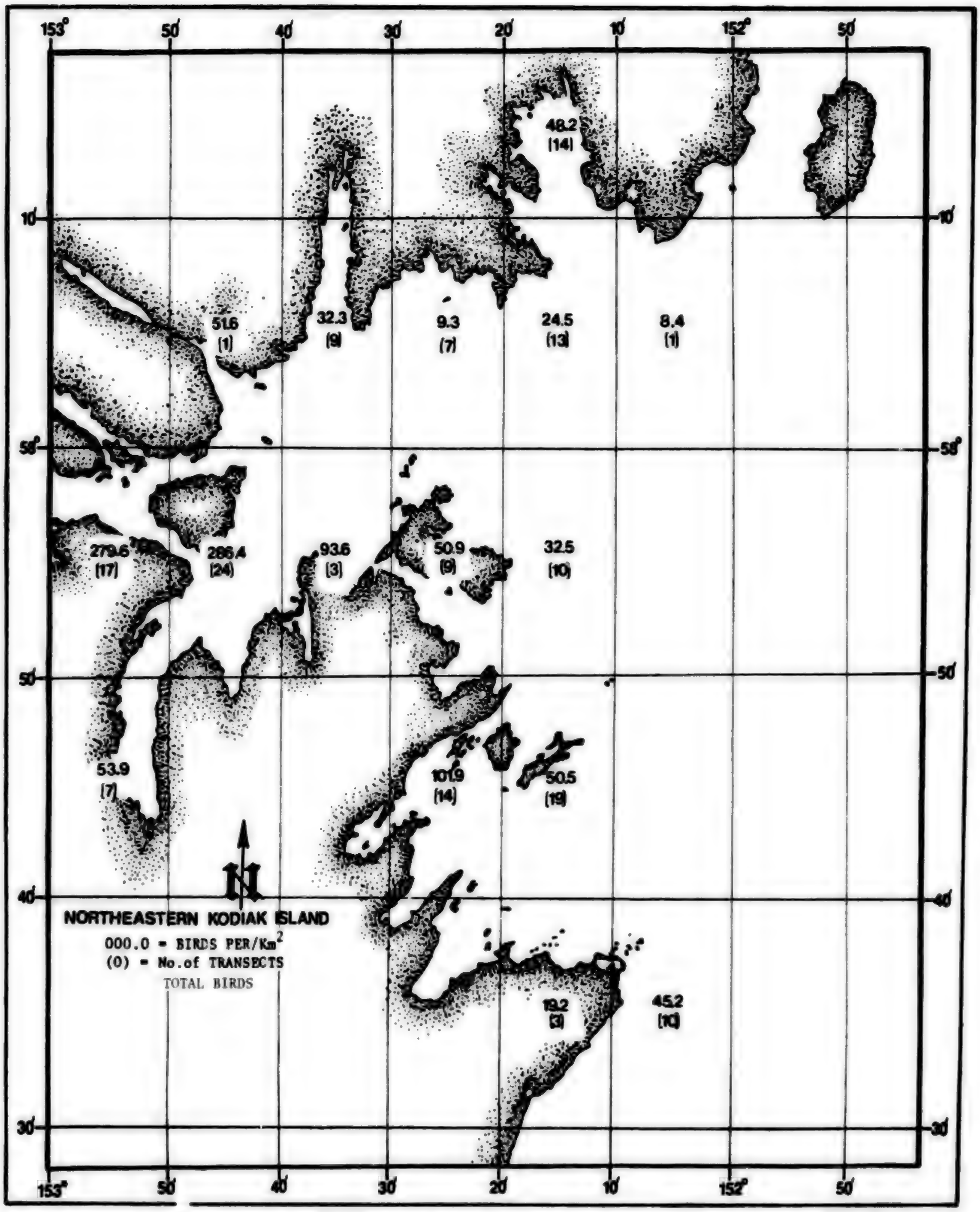

Figure 20. Density indices by 10-minute latitude and longitude blocks for Total Birds, Northeast Kodiak, February-March 1980.

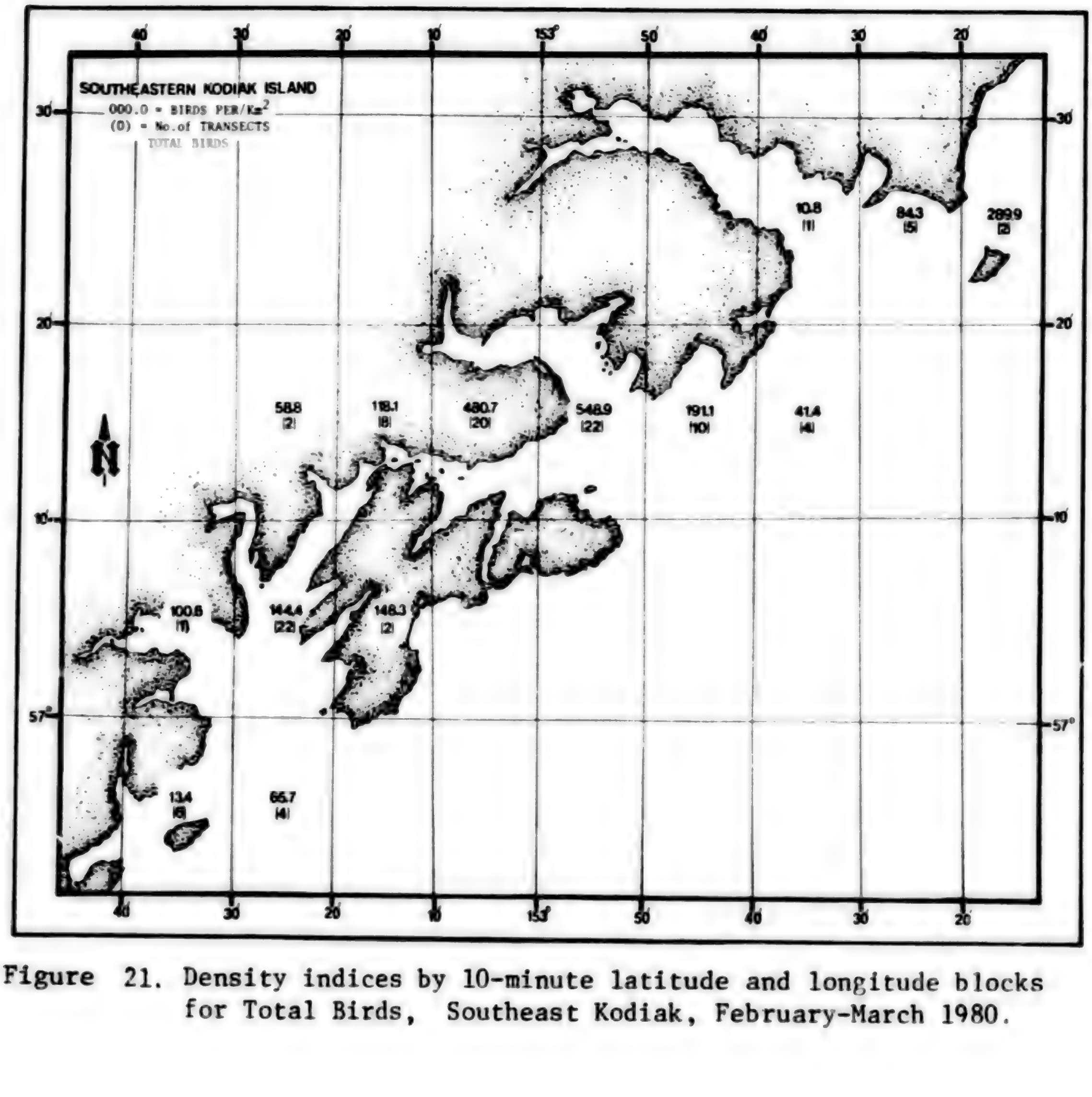

Figure 21. Density indices by 10-minute latitude and longitude blocks for Total Birds, Southeast Kodiak, February-March 1980.

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16. Abstract (Limit: 200 words)

Forty-four species of seabirds and ten species of marine mammals were observed during the winter of 1979-1980 in the Kodiak Archipelago. The species composition of seabirds in the area shifted considerably between summer and winter. Densities in the bays increased in the winter, whereas densities over the continental shelf decreased. Numbers in the shelf break and oceanic habitats showed a small increase from summer to winter. Prime habitats for seabirds wintering in the Kodiak area include ice-free estuaries and lagoons for puddle ducks; marine waters less than 25 m deep with rock substrates for seaducks; and waters near the 100-m isobath in mid-bay for murres.

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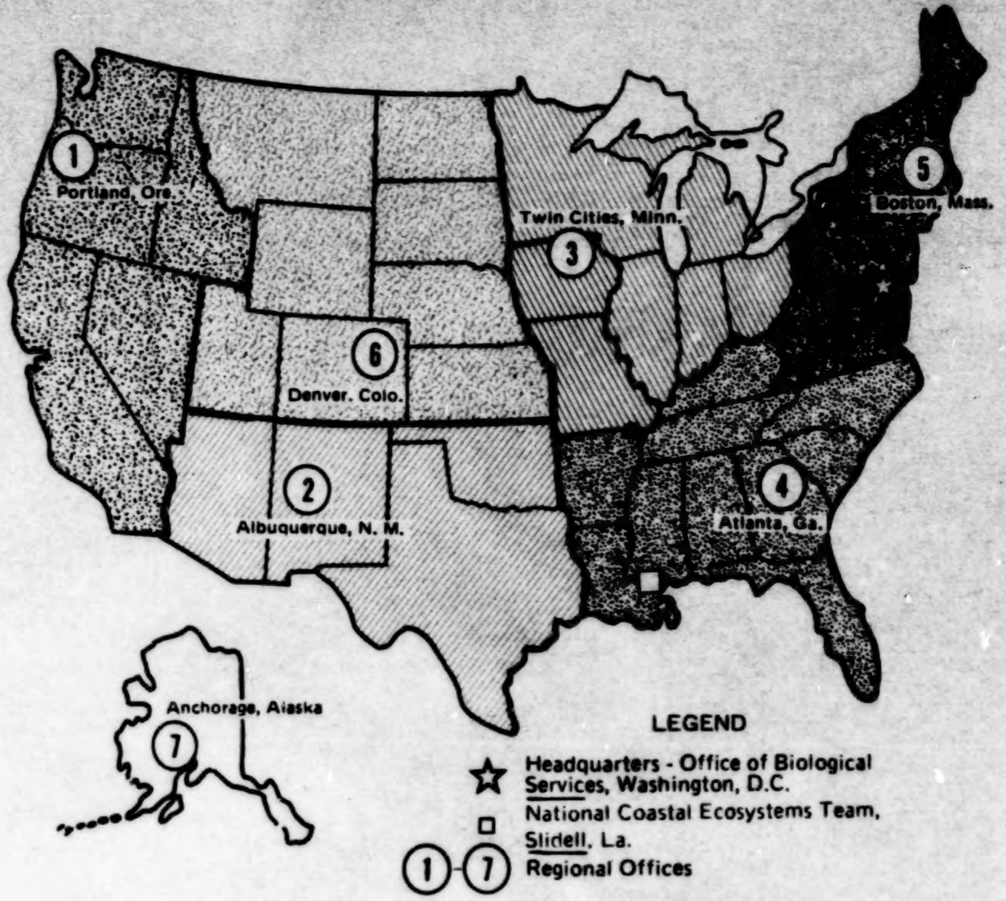

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